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Scientific Accuracy in Engineering Practice.

Engineering practice has come to be a body of procedures based largely upon scientific methods involving mathematical accuracy in their applications to engineering computations and design. This does not constitute, however, the entirety of engineering practice, even where the applications of engineering theory are as well defined and as precise in expression as in the design of simple bridge structures, for even there the judgment of the engineer, tempered by experience, plays a sufficiently important part to make the difference between success and at least a degree of failure. Before the great development in the physical sciences, and particularly mathematical science, between the middle of the eighteenth

and of the nineteenth centuries, the practice of the civil engineer consisted largely in following successful precedents and in the exercise of good judgment, but the development of the exact sciences made available well-defined methods of procedure which now govern the great body of engineering computations and design.

One of the most perplexing questions at the present time, especially to young engineers, and one which even experienced engineers by no means altogether escape, relates to the extent to which accurate mathematical and other scientific methods are to be allowed to govern the final results adopted in practical work. There is a great distance between the old-style engineer who relegated all theory to the scrap heap of mathematical rubbish and the hyper-refinement of the laboratory worker of to-day. The engineers of former years who even went out of their way to express contempt for advancing engineering knowledge were, in their way, great constructors, and accomplished many admirable works, but on the other hand, they also made their full share of failures, and the most of their works were ill-balanced in design, involving both extravagance in some directions and an insufficient margin of safety in others. The well-balanced professional engineer at the present time is one who pays due heed not only to the scientific method which underlies his procedures, but also to the well trained judgment which recognizes in proper proportion the effect of the complicating conditions in which the actual structure or machine performs its duty, as compared with the simple conditions which at least implicitly underlie every mathematical or physical theory.

The young engineer now begins his professional career as a rule after having acquired a body of more or less well digested scientific principles which form the true foundations of the various fields of engineering practice in which he is to choose his career. One of his earliest practical lessons will be, far from unlearning what he has acquired in the class-room, as has frequently been stated he must by so-called practical men, but to adapt that knowledge to the infinitely varying and complicating conditions of actual practice. Setting aside for the moment those considerations of policy or tact which must influence every man of affairs, whether he is an engineer or follows any other calling, the real professional skill of an engineer consists in a certain elastic facility in the adaptation of what may be called the natural philosophy of engineering to engineering works. If he is to design a retaining wall or a class of light foundations in earth he may, and probably will, find the theory of earth pressure a most useful agent in the work of proportioning the structures which he is to build. The results of computations based upon that theory may or may not be closely applicable to his work. In the case of wet ground an ill-considered use of the theory as applicable to a dry, granular mass may lead to disastrous results. At the same time there is probably not a method or theory in the whole range of engineering science of greater practical value to the well-informed professional engineer in most troublesome foundation and retaining wall work than such a theory of earth pressure as that set forth by Rankine, in which the numerical results of the application of formulas are not to be blindly accepted, but intelligently adapted to actual conditions. In reality the theory of earth pressure is one of the safest and most admirable guides to engineering judgment in a wide range of practical problems within the reach of the engineer, but there are required both a thorough knowledge of the theory and the conditions on which it is based and a well trained judgment to temper its application.

In another direction, that of bridge design, in which computations are supposed to be in the

highest degree well defined, not only in themselves but also in their applications, there are many cases in which an equally well trained judgment is fully as necessary as in the case of the theory of earth pressure. The design of pins in pin-connected bridges is based upon precise computations of bending moments and the results are applied in the design as if they were mathematically accurate, and yet every well-informed structural engineer knows that in most cases those computations are but loose approximations. Extended experience has shown that such inaccurate but conventional applications of theory lead to safe and suitable results, and they are, therefore, continually accepted.

It would be professional foolishness, not to put it stronger, to reject engineering theory in such cases for the reason that knowledge and good judgment are required for its proper use. The case exhibits rather the imperative necessity at the present time for both the accuracy of scientific method in engineering practice and good judgment based upon sound educational training and experience in dealing with actual engineering things. The precise degree of accuracy which is to be attained in any engineering computation must be determined by the exercise of that good judgment which has already been alluded to. As a rule computations ought to be accurately made with the understanding that the results are to be tempered by experience with the conditions of each case. This does not mean that decimals are to be used where even numbers will secure the attainment of an accuracy greater than that which can be realized under the actual conditions of practice. Engineering computations are not in the same category with those required in purely scientific work and it is an inexcusable waste of time to undertake elaborate computations when shorter and simpler procedures will abundantly meet the requirements of the case. In estimating the discharge of a weir from close and accurate observations a greater degree of accuracy will certainly be required than is involved in the determination of earth pressure against a retaining wall or in ascertaining the probable sustaining power of an earth foundation. No well-defined rule can be prescribed for such matters, but the broad and general principle may be laid down that the results of any system of computation must not be vitiated by loosely approximate procedures on the plea that the theory does not accurately fit the actual conditions. The adjustment should be made by good judgment acting upon those results and so modifying them as to make their applications reasonable and safe.

Gravel Concrete.

On one of the largest railways of the country the members of the engineering corps are now engaged in an animated discussion of the utility of gravel for concrete. On a number of sections there is no stone near the line which can be crushed to form a satisfactory aggregate, while there is plenty of fair gravel. Hitherto the use of this gravel has been discouraged for high-grade concrete, but the number of concrete structures to be built next season is so great that it is considered desirable to employ the gravel in all classes of work, if this practice can be justified. Probably a number of the readers of this journal have been asked by the railway to give their opinions on the subject, which is a rather important one deserving public discussion.

The objections raised to gravel are two-fold, first its liability to carry too much dirt, and second the smooth, rounded surfaces of the pebbles. The dirt feature is only troublesome in a few cases, and, moreover, there is a growing feeling

among engineers that they have been scared too much by a little loam or clay. It is possible that there will be some carelessness in this respect, resulting in crumbling structures, before the right quantitative views concerning dirt are thoroughly established. The smooth, rounded surfaces of gravel, provided they are reasonably clean, are not an objection to the use of the material for concrete. In many gravel pits the natural grading of the stones is such that a dense concrete can be made more easily than with screened broken stone and sand, and the fitting together of the pebbles and stones so reduces the voids to be filled that really good gravel concrete cannot be excelled in durability and appearance.

In considering this subject, there are at least six characteristics of gravel to which attention must be paid, the strength and durability of the stone, the size and shape of the fragments, the volume of the voids, and the character of the surface to which the cement must adhere. A discussion of these characteristics given by Mr. L. C. Sabin, in his "Cement and Concrete," leaves little to be desired in the way of further information. As gravel usually comes from igneous rocks its strength and durability are not often open to adverse criticism, not so often, in fact, as the same properties of broken stone. The size of the pebbles is manifestly of little comparative importance since, in the worst pits, the screening is very rarely more expensive than the grading of the product of a crusher.

The shape of the pebbles is not considered as important by Mr. Sabin as by some engineers, and his view is probably the better one. The round pebbles of the gravel slide readily over each other and do not interlock in such a way as to give the same kind of a bond as the angular fragments of crushed stone. The bonding property in concrete is by no means so necessary as in road construction, however, while the fact that the voids in gravel average from about 30 to 37 per cent. as against 40 to 50 per cent. in broken stone deserves much greater attention than it usually receives. The character of the surface exposed to the cement is of course important, but it may be questioned whether it has the influence on strength that is sometimes asserted. It is safe to say that the cement will not adhere so firmly to the smooth surface of gravel as to the fresh surface of stone of the same sort that has just passed through a crusher. On the other hand, adhesion of cement to stone is not simply a matter of smoothness or roughness, as it appears to the eye or touch, and the adhesion to limestone may be much greater than to sandstone, although the latter has a rougher appearance.

From the workmen's point of view, gravel is desirable for wet mixtures because it needs very little tamping to produce a compact mass, and the amount of cement required is small. On the other hand gravel does not bond like broken stone and the cement does not adhere to it as well as to the fresh surfaces of crushed rocks. It is evident, therefore, that the choice between gravel and broken stone must remain one of relative cost and suitability for each piece of work. Satisfactory concrete can be made with either material. One experimenter using a small percentage of mortar, so that the voids in the broken stone are not nearly filled, Mr. Sabin points out, may conclude that gravel is the better, while another experimenter using a larger amount of mortar, filling the voids in the broken stone and giving a large excess over what is needed for the gravel, will conclude that broken stone is much to be preferred. This is a matter, however, in which practical experience is worth as much as theory, and if the observations of any engineers are opposed to the views expressed above, information concerning them is requested for publication.

The Columbia Innovation.

In the annual report of the president of Columbia University, presented to the trustees of that institution this week by Dr. Butler, there will be found the most important announcement concerning higher education in the United States since the days when President Eliot led the revolt against the compulsory study of Greek in secondary schools preparing their pupils for entrance to Harvard. Harvard took the lead in recognizing that other subjects might be as broadening to a young man's intellectual development as the grammar and literature of ancient Greece. Columbia has taken the lead in recognizing that all students have not the same facility for acquiring knowledge of each and every subject on the curriculum. We all know by experience that some subjects we absorb readily without serious work, while others are mastered with difficulty, yet our system of higher education has taken no account of this fact. The new programme at Columbia is to remedy this incubus on individual development, and frees the student from the necessity of completing a certain number of years in colleges before graduating.

The faculty of Columbia say explicitly that to prescribe graduation from a four-year college course as a *sine qua non* for the professional study of law, engineering, medicine, or teaching is not to do a good thing but a bad thing. It is to set a high standard, measured quantitatively, but a wrong standard, measured educationally. It is to put the colleges and professional schools in a false attitude before the public and to confuse rather than to solve the social and economic problems by which higher education is now surrounded. "The notion that either culture or efficiency will suffer," Dr. Butler says in his report, "by putting a stop to the indefensible waste in education, which our national spirit of wastefulness has permitted to grow up, is ludicrous. Any culture that is worthy of the name and any efficiency that is worth having will be increased, not diminished, by bringing to an end the idling and dawdling that now characterize so much of American higher education. The whole difficulty has arisen from a tendency, in its origin sound and valid, to raise the standard of education. This tendency, however, soon passed into a tendency to increase requirements for admission to the various types of institution, without stopping to consider whether this step improved standards and made education more efficient or not." For these reasons the Columbia students will be granted degrees when they have completed prescribed courses, no matter whether they accomplish the work in two and a half or five years. So far as possible the courses will be planned so that the students who absorb a subject rapidly will not be held back by those who find it more difficult, while those who require considerable assistance from instructors in grasping the successive stages of a subject will not be forced along so rapidly that the information they obtain is so superficial as to become worthless.

While this view of college education is comparatively novel in America it is thoroughly established in Germany, where students go from one university to another to hear the lectures of the most distinguished professors on the subjects in which they are interested until finally they consider themselves sufficiently trained to receive the coveted doctor's degree. Then they are examined before a board of professors who subject the candidate to a searching examination on all the subjects he has been studying. It seems that the Columbia plan, applied to less advanced studies, is different from this in two respects, first, that the students are expected to spend most of their time, at least, at that university, and sec-

ond that provision will apparently be made by which certain professional subjects may be studied at the same time that the college course is being taken. It is to be hoped that this attempt to reduce the duplication of studies and the waste of time, so obvious in higher education in America at the present time, will be successful, for, as Dr. Butler truly remarks, the American people are most wasteful in their habits. We are getting over this serious fault, however, as the Columbia innovation shows, and as soon as the importance of thrift as compared with wastefulness is better recognized in the homes as well as in the industrial establishments of the country, we will look back on the present habits of useless dawdling with the same aversion that is shown to-day toward the gluttony and drunkenness of our great-grandfathers.

Engineers In the Navy.

The engineer-in-chief of the United States Navy, Rear Admiral Charles W. Rae, indulges, in his annual report, in some very plain words concerning the condition of the country's fleets as a result of the corps jealousy in the navy of late years. Coming on top of the universal hearty applause of Secretary Bonaparte's determination to bring culpable line officers to punishment for neglect of their duties on the "Bennington," it is a welcome indication of the probability that the autocratic position of the line will soon be a thing of the past. Theoretically, of course, the engineer is now a line officer, and vice versa, but practically the conditions in the engine room are even worse than before. Every man who has any intelligence knows that a modern war vessel is nothing but a mass of intricate mechanism. It is an engineering structure, designed by engineers and capable of safe management only by engineers. Yet for many years it has been the custom of line officers to treat the engineering officers as of little account, to harass them in various ways very galling to an officer, and to deny them in some cases the favor of elementary justice in courts martial. As a result of this engineering service became extremely distasteful and an attempt was made to improve it by abolishing the distinction between line and engineer officers. This remedy has been a failure up to date. As all midshipmen at the Academy are given instruction in steam engineering, no examination other than that required for promotion was demanded of them, under the new system, for qualifying for performing at once engineering duty in subordinate capacities, which was the interest of the personnel bill. How this purpose was avoided is explained by Admiral Rae as follows:

"Owing to the absence of specific instructions in the personnel bill, combined with powerful adverse influences within the Department, for three years absolutely nothing was done by the younger line officers in acquiring engineering experience, and later, owing to the large number of ships kept in commission and the scarcity of officers, but little in that direction was accomplished. But for the availability of certain retired naval officers, the Bureau of Steam Engineering would experience great difficulty in finding officers for the various responsible positions, both on shore and at sea. So few officers of the line are taking up engineering seriously that the situation is becoming alarming. Were the country suddenly plunged into war, the Navy would find itself in no condition to win battles. As necessary as good marksmanship is the ability to carry our guns to the firing line and to keep them there amid the havoc created by modern ordnance, and this will never be done with amateurs in charge of the machinery. That line officers can become good engineers has already been

proved, but they must have experience to become so, and that experience must be acquired in subordinate positions. No young officer out of the Academy but a short time, who would not be given charge of the deck except under the supervision of a senior officer, should be placed in charge of the engineer department of a ship, as has been done. Engineering logically belongs to the line, and the line should be made to perform that duty earnestly."

The recommendations of Admiral Rae for the improvement of these conditions are substantially the same as in his report of last year, reviewed in this journal on Dec. 10, 1904. There has been no change in the situation during the last year, except as the explosion of the "Bennington" has demonstrated that the old regime that has controlled the inner workings of the department isn't fit to be in charge of the boiler of a green corn huckster. The same adherence to the methods of a past generation that made the performances of some of our generals at the last army manoeuvres the laughing stock of those who knew what modern warfare really is has apparently sealed the eyes of our naval line officers to the fact that the man who fights down in the bowels of a ship is just as necessary for success as the fellow in the turret. Both are brave men, doing their duty well, and it is a pity that in times of peace they must squabble about relative precedence and other non-essentials until the service suffers. If the line is willing, for the sake of retaining its prerogatives, to run the risk of being elevated rapidly to Heaven, a la "Bennington," that is its own lookout; but the people of the country are getting mighty tired of paying the bills for such "tours de ignorance." It is very much easier to provide battleships and cruisers than competent officers to manage them. The mechanical complication of a war vessel is so great that it takes years of training to fit a man for the responsibilities of executive management, while the little coterie of line officers in Washington that claims to be the embodiment of all the best thought in the Navy Department still adheres to the opinion that engine room commands can be safely entrusted to ensigns and warrant officers. The Department needs engineers more than anything else; men who are specialists in steam engineering and awake to the progress that is being made in such work in all parts of the world. It is only necessary to consider the helplessness of a war vessel with inefficient machinery to recognize that Admiral Rae's recommendations for obtaining such men deserve the hearty support of the Navy Department and Congress.

Notes and Comments.

PIPE WELDING BY THERMIT has recently been successfully accomplished for the Manhattan Refrigerating Co., of New York. The pipes were laid on 14th St. and used to convey liquid ammonia. In all twenty-nine 1¼-in. and seven 2-in. joints were welded, the lengths being connected in this way on the ground in sections from 40 to 100 ft. long. The sections were then placed in the trench, cuts made for the connections and the final welding done with the pipe in place.

THE FAILURE OF A DAM which was reported from Necedah, Wis., some time ago in various newspapers turns out to have been the result of another attempt to found a structure on sand, as the following note from the owner, Mr. F. M. Reed, fully explains: "In regard to damage to my dam across Yellow River I will say that the foundation on the east side of the river was sand. Instead of putting down sheet piling until they struck hard-pan, the contractors simply put down a concrete wall about 2 ft. deep and 4 ft.

wide, resting on sand. A small head of water washed the sand out from under the foundation and let the concrete settle about 3 ft. in front of the dam. Where the walls are cracked some pieces of gravel as large as a goose egg are broken across, so you can see that the concrete was all right."

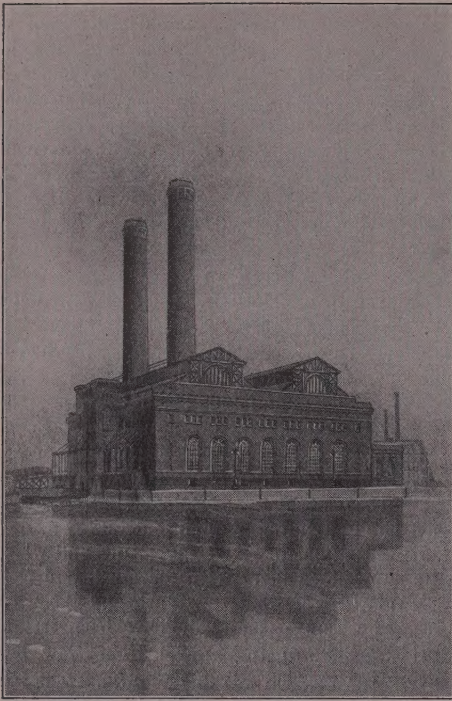
THE COPPER SULPHATE TREATMENT of water supplies is the subject of a census now being taken by Mr. C. W. Sherman, editor of the "Journal" of the New England Water-Works Association. As the data already collected indicate that the report on the subject will be of much value, The Engineering Record has no hesitation in advising its readers to co-operate with Mr. Sherman by sending him a statement of the area and capacity of any body of water treated under their direction, the number and character of the organisms causing trouble, full particulars concerning the date and manner of each application of copper sulphate, and a statement of its effect on the organisms, the tastes and odors, and the fish in the water. This information should be sent promptly to Mr. Sherman, at 14 Beacon St., Boston, as the results of the census are to be published next month.

TESTS OF A STEAM SEPARATOR made by Messrs. Willans & Robinson were described by Mr. C. H. Wingfield at a recent meeting of the Institution of Mechanical Engineers. The steam first passed from a horizontal main into a separator, where it impinged directly on a vertical wall which was assumed to intercept any entrained moisture and cause it to fall down to the bottom of the separator. The steam from this apparatus was then carried upward into another separator of the same design. If the first apparatus was entirely successful the only steam that would collect in the second one would be the condensation in the well-lagged connection between the two. In the tests it was found that with low velocities about 60 per cent. of the moisture was collected in the first separator and 40 per cent. in the second. With rapid velocities these percentages were reversed. Mr. Michael Longridge stated that he had observed the same result, which was due to the fact that the steam rushed through a separator with the velocity of a gale of wind. If one tried to beat out the water against a single vertical face normal to the current, the water was simply scattered into small drops, which could be carried away by the rush of the steam. It was far better, in his opinion, to take advantage of the momentum of the water particles by deflecting them against a curved surface.

THE ERIE R. R. was seventy years old on Nov. 7, for at sunrise on that date in 1835 construction on the road was begun at Deposit, N. Y., in the presence of the leading officers of the company and several well-known men in State affairs. In 1851 the completed connection between the Hudson valley and Lake Erie was celebrated by running a special train from Piermont to Dunkirk, an event of sufficient importance to be honored by the presence of President Fillmore and Daniel Webster. When ground was broken for the first work, the president of the company stated: "What is now a beautiful meadow will, in a few years, present a different aspect; a track of rails, with cars passing and re-passing, loaded with merchandise and the products of the country. The freight will amount to 200,000 tons within a few years." Last year the Erie road hauled 29,835,105 tons of freight, so that it is safe to say that President King did not exaggerate. To commemorate this important event in its history, as important to the people of the Delaware valley as to the railroad, the company has erected at Deposit, at the precise

spot where the first sod was turned, a large stone on which is a bronze tablet designed by Tiffany & Co., and bearing the following inscription: "Here, on the morning of November 7, 1835, ground was broken for the construction of the Erie Railroad, designed to connect the Atlantic Ocean with the Great Lakes. Its completion to Lake Erie was publicly celebrated in the City of New York and along the route to Dunkirk, May 14, 15 and 16, 1851."

THE GREAT IMPROVEMENTS on the New York, New Haven & Hartford R. R. since Mr. Mellen became president deserve careful attention. He was engaged to run a railroad, but he has had to build one. The chief of the difficulties with which this giant undertaking bristles are the overtaxing of the New York division, the congestion at the New York terminus, consequent upon the necessity of moving freight around Manhattan Island, the inadequate accommodations afforded by the Grand Central Station, and the long, narrow two-track cut in New Haven, through which all traffic destined there from the north and east, and beyond there from New York and the west, must pass. Contracts already have been let for the six-tracking of the branch from New Rochelle to the Harlem River, and work soon will begin. The present two tracks long have been so overcrowded as seriously to interfere with the free movement of not only freight, but, not infrequently, of passenger trains. Along the Harlem water front immense freight yards are being laid out, and more than 800 acres will be covered with tracks and switches. A great suburban terminus on the Harlem River also is planned, whereby trains will connect with the subway expresses that tap the heart of New York's business district, thus providing a quicker and pleasanter route for suburbanites, and affording extra room in the new Grand Central Station for the accommodation of through trains and their passengers. The new stations will be for electrically operated trains only, and the twenty-five locomotives recently ordered will draw expresses from Woodlawn to 42d St. When the late President Clark turned the main line from New York to New Haven into a four-track road, he provided only two tracks for the long bridges at Cos Cob, Westport and Naugatuck Junction. These three gaps will be filled out within a year with entirely new bridges, designed to bear the greater weight of the new locomotives and rolling stock. A new bridge at South Norwalk has been finished recently, and other structures are being rebuilt in many parts of the system. The control of the Ontario & Western R. R. was acquired by the New Haven for the purpose of opening up a new channel for freight between New England and the West. The Ontario & Western & New England Railroad, now the Highland Division of the Consolidated, runs from Campbell Hall, across the Hudson River at Poughkeepsie to Danbury, Waterbury and Willimantic. To accommodate the increased traffic that is destined to flow through this channel the line is being double tracked as rapidly as possible, and the Poughkeepsie Bridge is being strengthened, as described in this journal on Oct. 28. Still another route from the Hudson to the Connecticut is the Central New England R. R., now under the control of the New Haven, which runs from Poughkeepsie to Hartford and Springfield. With the double tracking in the near future of the line from Waterbury to Hartford there will have been provided not only an alternative to the main line from New York in a double track freight route from the coal regions into the heart of New England, but a double track line from Naugatuck Junction through Derby to Hartford, avoiding altogether New Haven and its present restricted tracking facilities.



The Port Morris Station.

The Power Stations for the Electric Zone of the New York Central R. R.

The current for operation in the electric zone of the New York Central & Hudson River R. R. will be generated at two power stations, one at Yonkers on the Hudson Division, and the other at Port Morris on the Harlem Division, the two stations being cross-connected and each having an ultimate capacity of 30,000 kw., which is sufficient to carry the entire load of a train service much greater than that now operated by steam. The locations adopted, besides being near the load centers of the electric traction system, are advantageous because they are on the water front and are also adjacent to existing tracks, thus being convenient of access for delivery of coal by boat or cars.

The main buildings which enclose the boiler rooms, coal bunkers and the generating rooms are 167 ft. wide, 237 ft. long and 105 ft. high. The switch houses are separate buildings located about 40 ft. from the main power stations. The design of these power stations gives economy in space for the current generated, the number of cubic feet per kilowatt capacity being 102, the number of square feet of building per kilowatt is 1.49.

Foundations.—At Port Morris the solid rock is sufficiently near the surface to warrant carrying the concrete foundation down to it, and at Yonkers a bed of hard sand and gravel forms a good bottom for a pile and concrete foundation on the particular location selected, whereas borings taken along the river front over all other portions of the territory near the load center of the electric traction system showed either a great depth of silt or other unfavorable conditions.

At Port Morris a concrete bulkhead, built along one side and the outer end of the building to form a slip and dock (see Eng. Record, March 4, 1905), was used as a portion of a cofferdam for the excavation of the foundation, an existing embankment over a sewer forming one wing to reach the shore and a timber cofferdam forming the other. An intercepting ditch on the land side caught the water which drained in from a swamp, and this, together with the seepage through the cofferdam, was easily disposed with pumps.

Excavation was made to rock over the entire area covered by the buildings. In some places the rock was disintegrated and in others it was extremely hard. The surface also was very irregular, making a wide variation in the height of the piers, the maximum height being about 34 feet. A portion of the rock was excavated in order to build the intake and discharge tunnels of the circulating system for the condensers at the proper elevation.

At Port Morris the piping for steam and other connections to the turbine room is carried through tunnels under the floor of the power house. After building the tunnels and piers for columns and foundations for the generators and boilers, the area was filled with sand up to the level of the floor. The concrete floor and walls of the pipe tunnels which extend below the water line are waterproofed with alternate layers of coal tar pitch and felt.

The work on the foundations here included 26,000 cu. yd. of earth excavation, 4,500 cu. yd. of rock excavation; 16,500 cu. yd. of concrete; 5,000 sq. yd. of waterproofing, and 25,000 cu. yd. of back filling. The slip and bulkhead wall required 11,000 cu. yd. of earth excavation; 5,000 cu. yd. of rock excavation, and 3,500 cu. yd. of concrete.

The Yonkers power station is built entirely on land under water at a point where the main line of the Hudson Division runs along the bank of the Hudson River with only a ripped slope outside of the tracks. The land on the other side of the tracks rises abruptly and is valuable for residential purposes.

On the site selected for the power station (see Eng. Record, Dec. 10, 1904), the water runs from a depth of 8 ft. near the shore to 16 ft. at the outer end, the bottom being sand and gravel. As the first step in construction, the piles forming the foundation, spaced in general 3 ft. apart under walls, piers and machinery and somewhat further apart under the floor, were driven to refusal, four marine pile drivers being employed in the work. The area was then surrounded with a cofferdam formed of a single course of 12 x 12-in. timbers with 3 x 4-in. strips spiked to the edges so as to form a tongue-and-groove joint. The driving point of each timber was beveled on the edge away from the timber previously driven, in order to force them as close together as possible, and great care was taken to see that no pebbles or other obstructions were allowed to get between the timbers and open the joint. Some of the joints which leaked between high and low water as the water was being pumped out were battened with canvas and a few joints under water were calked by a diver. When the water was finally pumped out, however, there was no difficulty in keeping the bottom dry with an 8-in. pump, although the interior was excavated to a depth of about 20 ft. below the surface of the water at the outshore end. The piles were in general cut off at an elevation of 8 ft. below mean high water and the bottom of the concrete foundations was laid one foot below the heads of the piles.

Under the intake and discharge tunnels for the circulating system for the condensers the bottom of the concrete reached a depth of about 18 ft. below high water, and a depth of 13 ft. under the tunnel for the coal and ash hoist. In the Yonkers power house there is no pipe tunnel under the floor as at Port Morris, the piping in the turbine room being carried under transverse galleries.

The main bed of the concrete foundations is 4 ft. thick, above which the walls and piers for the superstructure and machinery are carried up individually, the spaces between being

filled with 5 ft. of sand, over which a 6-in. concrete floor is laid.

Waterproofing consisting of alternate layers of coal tar pitch and felt is laid in a horizontal plane in the concrete bed at an elevation 6 in. above the tops of piles and is carried up the side walls above high water. Six-ply waterproofing is used in all horizontal planes, five-ply in all vertical planes in the building, and four-ply around all ducts exposed to surface or tide water.

In order to take up any tensile stresses in the foundation two courses of round steel rods one inch in diameter are laid in each direction at right angles to each other in the bed of concrete above the plane of the waterproofing. The foundation work at the Yonkers station includes 5,540 piles; 16,500 cu. yd. of concrete, 270 tons of reinforcing rods, and 9,000 sq. yd. of waterproofing.

Superstructure.—Aside from the foundations, the two power stations are similar in general design. The base and floors are of concrete, the framework of steel, all designed so as to give no inaccessible surfaces; the walls are brick and tile, and the roofs are of concrete roofing slabs covered with copper, with standing seam joints. There are 2,800 tons of steel structure in each power station.

Architecturally, the power stations have been designed with the idea of using the large proportions to obtain an impressive effect merely by the use of common brick and terra-cotta of the same general color, relieved through careful design of the openings and recesses, but without any special ornamentation. The result gives economy in construction in proportion to the capacity. Special consideration was given to the design of the windows, not only to obtain a well lighted interior, but also to present a striking and attractive appearance from the exterior at night, both power houses being located along the line of important water travel, besides being adjacent to railroad lines. The prominent feature of the design is a row of eleven arched windows of 10-ft. span on each side, lighting the main floors. A good effect is obtained by placing three small windows over each arch, these windows serving to light the upper gallery floor. The large window frames are all of built-up steel, the mullions being glass and steel, giving the largest possible area of lighting surface. In the gable ends the lines of the end roof truss are left exposed, the spaces between the members being filled with concrete slabs, giving the effect of half-timbered stucco construction.

There are two Custodis radial brick stacks, 15 ft. 6 in. inside diameter and 250 ft. high above grates, at each power station. They are supported on steel columns and a concrete and steel staging 40 ft. above the boiler room floor, the main boiler room alley passing underneath.

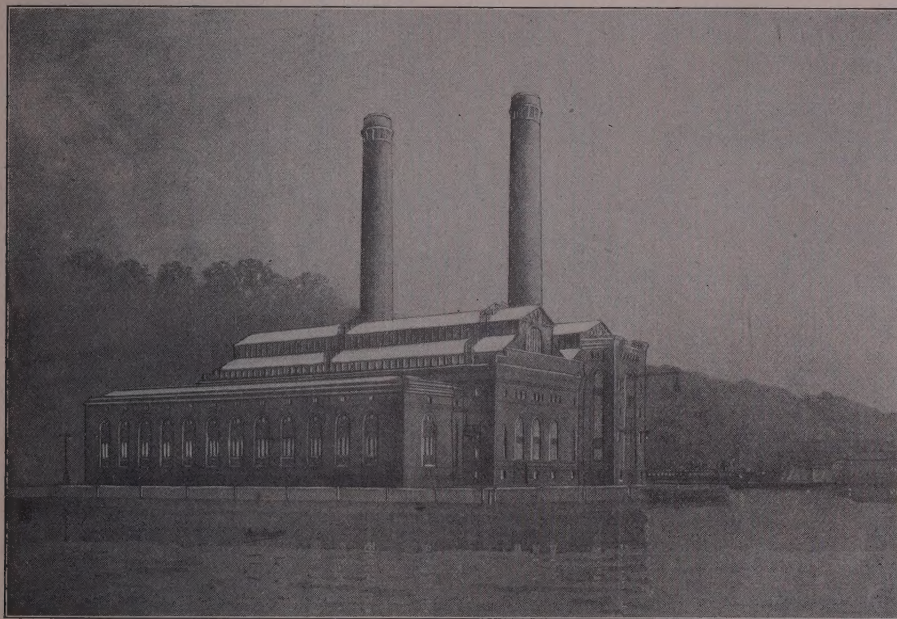
In interior arrangement the power stations are divided by a brick wall into the turbine room, 69 ft. x 231 ft. 8 in., which is open to the roof, and a boiler room 88 ft. x 231 ft. 8 in., over which the coal bunkers of 3,500 tons capacity are placed.

At Port Morris there are three galleries on one side of the turbine room, the first gallery being used as a shop, the second as operating gallery and the third for offices. At Yonkers the level of the first gallery is carried across the room as the operating floor with walkways between the generators. The exciters are placed under the galleries on the level of the operating floor, the operating gallery being immediately above them and the top gallery being used for offices and shops.

Coal and Ash Handling.—Coal delivered at the power stations on cars is dumped from the cars into pockets from which it is delivered by sus-

pended flight scraper conveyors into the hoppers of crushers where it is reduced to the proper size for handling with the mechanical stokers. From the crushers it passes into a pocket conveyor which lifts it to the top of the building and delivers it to longitudinal conveyors of the suspended flight scraper type which dump it into the coal bunkers over the boiler room. From the bunkers it is delivered through vertical downspouts to Roney mechanical stokers, operated by steam.

The ashes drop from the grates into hoppers, from which they are collected in push cars of one-ton capacity running in an ash tunnel in the boiler room basement. These cars are dumped into a hopper from which the ashes are lifted by means of a bucket conveyor into an ash-storage bin directly over the coal trestle, from which they can be dropped through a spout in the bottom of the hopper into a car. Cars on the trestle are spotted by means of an electric winch. Coal delivered by boat is hoisted in a clam-shell bucket of one ton capacity, operated by a steam hoist. The coal handling capacity is 80 tons per hour and the ash-handling capacity is 25 tons per hour. The maximum coal consumption at the power stations will be about 220 tons per day.



The Power Station near Yonkers.

Aside from the hoist for unloading coal from boats, which is operated by steam, the coal-handling apparatus is all driven by electric motors. The conveyors are driven by 220-volt, three-phase induction motors, varying in capacity from $7\frac{1}{2}$ h. p. for the ash conveyor to 40 h. p. for the coal crusher and conveyors.

Boilers.—Each station is designed to accommodate 24 Babcock & Wilcox water-tube boilers, rated at 625 h.-p. each, all located on one floor and arranged twelve on each side of a central alley. Sixteen boilers will be installed for initial use. The heating surface of each boiler is 6,250 sq. ft. and the grate surface 112 sq. ft. The boilers are designed for a normal working pressure of 185 lb. and the steam will be superheated to 200° Fahr. over and above the temperature due to steam pressure. The superheaters in each boiler will contain 1,230 sq. ft. of heating surface and they are made up of 168 2-in. tubes each 13 ft. 5 in. in length. Each section of the power station containing four boilers is equipped with one boiler feed pump of the duplex outside-packed piston type. The pumps are designed for hot water, and each pump has a sufficient capacity to supply eight boilers under full load conditions. The feed-water heaters are of the closed type corru-

gated tube Wainwright counter-current design.

Piping.—The piping is all mild steel with flange joints of a modified Van Stone pattern. Four boilers are piped direct to one turbo-generator and, by means of cross-connections, adjacent boilers can be arranged to supply turbo-generators of the next group. The sectional system of piping has been followed throughout for the auxiliary machinery.

Cranes.—The turbine room of each power station will be equipped with a 50-ton traveling crane having an auxiliary 10-ton hoist.

Turbo-Generators.—Each power station is designed to accommodate six 5,000-kw. turbo-generators, four of which are being installed for initial operation. The turbines are of the Curtis five-stage vertical type. These machines are about 15 ft. in diameter at the base and 35 ft. high from the floor to the top of the generator.

The turbine structure is mounted on a cast-iron base forming an exhaust chamber, in which is provided the opening to the condenser and to the free atmospheric exhaust. The shaft of the turbine is separated from that of the generator above, the connection between the two being made by a coupling so that the machine can be readily taken part.

resistances, connected to a common ground bus, limiting the ground current to an amount sufficient to operate the line overload relays. The leads of the generators are brought down to the floor through brass pipes to the ducts leading to the high-tension switches, the arrangement being such that no high-tension conductors are exposed in the turbine room.

Condensers.—The condensing apparatus is external to the turbines. The condensers are of the counter-current surface type. Each is directly connected to its turbine base and contains about 17,000 sq. ft. of cooling surface. They are guaranteed under full load to maintain a vacuum of 28 in. with cooling water at a temperature of 70° Fahr. and 30 in. barometer.

The auxiliary condensing apparatus is composed of independent units. Circulating water pumps are of the centrifugal type directly driven by horizontal reciprocating engines. The dry vacuum pumps are of the rotative fly-wheel type with air and steam cylinders in tandem, erected on a common base. The hot well pumps are of the two-stage turbine type and are driven by direct-connected direct-current electric motors.

As an evidence of the high efficiency expected of the condensing system, it may be stated that the manufacturer has guaranteed that the temperature of condensed steam measured in the condenser hot well will be within 1° Fahr. of that corresponding to the pressure measured in the condenser. All parts of the machinery have been designed to operate smoothly and quietly under all loads up to 50 per cent. above the normally rated capacity of the turbines. The intake and discharge circulating tunnels for the condensing systems are elliptic in shape, 7 ft. $3\frac{1}{8}$ in. x 9 ft. 11 in.

Exciters.—The exciter system at each power station will consist of two 150 kw. turbo-generators, and one 150-kw. induction motor-generator furnishing current at 125 volts pressure; also one exciter storage battery consisting of 74 cells, having a capacity of 1,200 amperes for one hour, with spare space in the tanks for increasing the capacity to 1,800 amperes for one hour. Exciter generators and battery are connected to two independent positive busses and one common negative bus. The battery has two end cells on the positive side. One positive bus serves for field excitation of the 5,000-kw. generators only, while the other serves for certain lights and motors in the station.

Operating Gallery.—The stations will be operated from the operating gallery on the north side of the turbine room. The arrangement of the switchboards in this gallery is symmetrical, and all cables and copper connections running to the switchboards are carried in concrete trenches under an alberene stone floor. The main operating switchboard containing all the control switches and the instruments necessary for the operation of the station is located in the center of the operating gallery. A set of two exciter switchboards is located on each side; the main operating switchboard, as well as the exciter switchboards are enclosed in an operating booth constructed of steel and wire glass. Three field switchboard panels are located outside on each side of the operating booth. An alternating-current and direct-current light and power switchboard on either end of the operating gallery complete the switchboard installation in the turbine room.

Switchhouses.—At both power stations switchhouses have been provided separate from the main building, with the idea of obtaining the best conditions for the installation of high-tension switching apparatus, and at the same time increasing the safety of operation. At Port Morris the switchhouse is 50 ft. 10 in. wide by 100 ft. long.

The shaft is borne by a step-bearing consisting of two cast-iron blocks between which water is used for lubrication under a pressure of 800 lb. per square inch, exerting a sufficient force to slightly raise the moving structure. One individual pump is provided for each turbine for the lubricating system, and in addition to this, two larger pumps in connection with two accumulators insure uninterrupted pressure at the step-bearings.

The governing will be effected by successive opening and closing of automatic hydraulically operated valves which deliver steam to the different sections of two sets of nozzles. The turbines will be fitted with two centrifugal devices to check any excess of speed. After either one of these devices operates, the next revolution of the machine will bring it into engagement with a lever which will trip the main steam valve, cutting off immediately the driving power and allowing the machine to come to rest in the shortest possible time.

The generators each have a capacity of 5,000 kw. and are wound for three-phase current of 25 cycles and 11,000 volts pressure. The armatures are star-connected and the neutrals are grounded through individual cast-iron grid

At Yonkers the switchhouse and the sub-station for that district are combined in one building 37 ft. 4 in. wide by 255 ft. 4 in. long; the switchhouse occupying 147 ft. 8 in. of the length and the sub-station 107 ft. 8 in.

In the switchhouses are installed the high-tension switching equipment, consisting of bus-bars, oil switches, instrument transformers, etc., also such instruments as are required for the complete equipment of generating stations, but which are not essential for the operator. The switchhouse contains further, auxiliary boards which allow the main operating switchboard in the turbine room to be put out of service if it should be desirable for the purpose of cleaning and repairs. These boards will also permit the operation of the station should, by an accident, the main operating board become disabled.

The high-tension busses, to which the generators are connected by means of a main switch and two selector switches, are installed in the basement of the switchhouses. The feeders are equipped with selector switches only. Overload relays are installed in the generator and feeder circuits, but the generator relays will operate only under very extreme conditions.

In the generator circuits, in addition to overload relays, reverse current relays will be installed; these, however, are connected to indicating lamps only, not tripping the oil switches. All relays are of the inverse time limit, belows type.

All high-tension connections and apparatus are located in the basement of the switchhouse, and no such apparatus is located on the first floor, except the oil switches to which connections are made from the basement through the floor. The

closed in vertical brick and alberene stone compartments, and all high-tension connections will be separated by brick or alberene stone barriers. The oil switches can be disconnected from the high-tension system by means of knife switches located in the bottom of the oil switches accessible from the first floor. This arrangement prevents accidents which might be made by mistake in disconnecting switches from live parts. All cables coming through the duct system from the power house enter manholes in the basement of the switchhouse, the arrangement being such that high-tension cables enter the high-tension compartments entirely separated. Low-tension cables enter through manholes in a passage separated from the high-tension compartments by a fireproof wall and are brought up in enclosed chases in the wall, so that they are positively insured against any accidental connection with high-tension conductors. The oil switches have a rated capacity of 500 amperes, except the bus-tie switches which have a rating of 1,200 amperes.

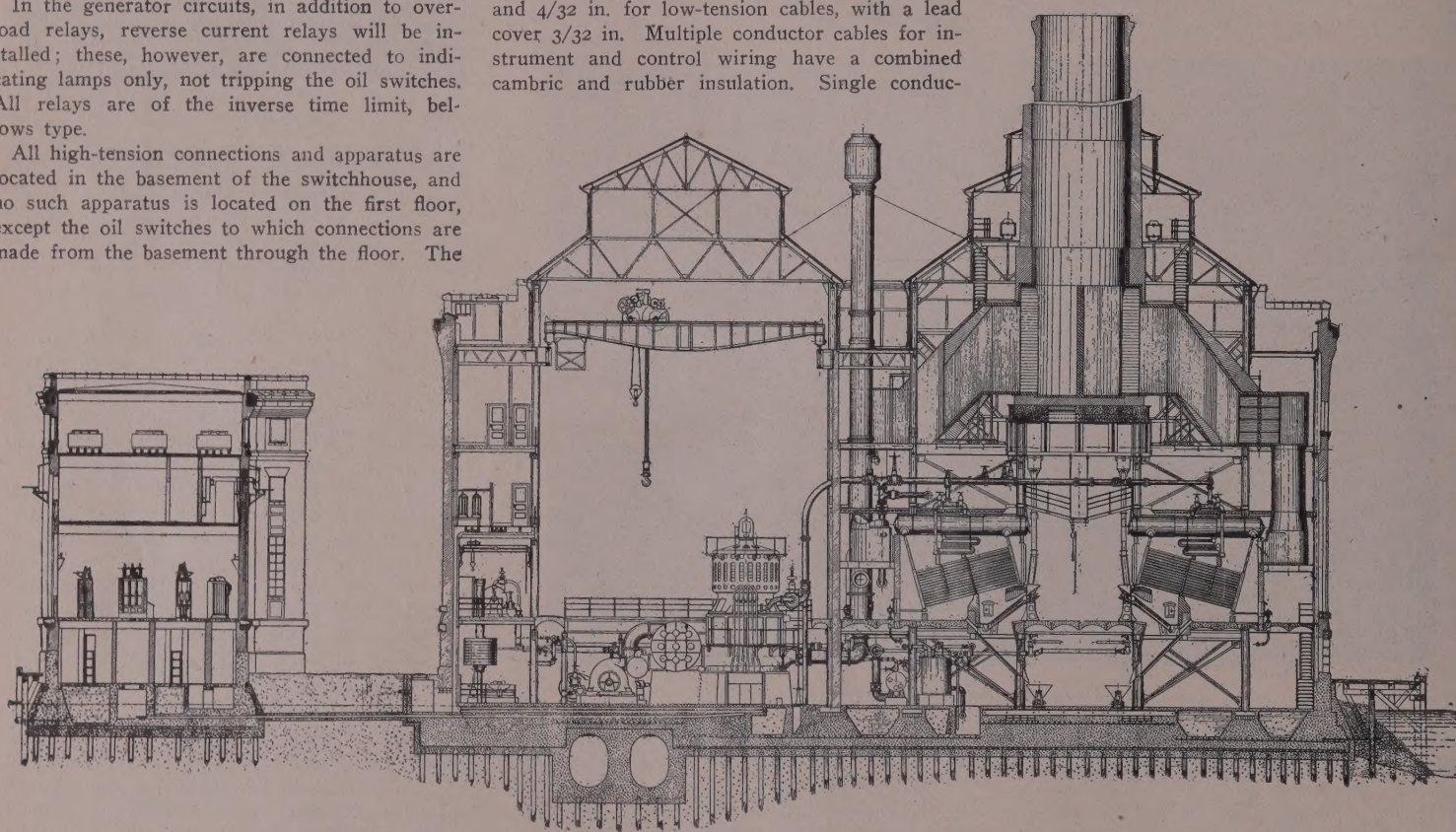
Cables.—All high-tension cables and the majority of the single conductor low-tension cables are cambric insulated and lead covered, the insulation being 10/32 in. for high-tension cables and 4/32 in. for low-tension cables, with a lead cover 3/32 in. Multiple conductor cables for instrument and control wiring have a combined cambric and rubber insulation. Single conduc-

tors, lines, rotaries, etc., are in or out of service and which switches are open or closed.

An independent telephone system exclusively for the use of the load dispatcher, interconnecting both power stations, all sub-stations and the train dispatchers in the electric zone will be installed.

Organization.—The entire engineering work outlined is under the charge of Mr. W. J. Wilgus, vice-president, whose staff is organized in three divisions, concerned with electrification, construction and architecture respectively. The electrification has been planned in its general features by the Electric Traction Commission, of which Mr. Wilgus is chairman, Messrs. J. F. Deems, B. J. Arnold and Frank J. Sprague are members, and Mr. Edwin B. Katte, the company's electrical engineer, is secretary. The details of the power plants described in this article have been worked out under Mr. Katte's direction. Messrs. Read & Stern are the architects, the foundations having been designed in the engineering department of the railroad company.

The principal contractors on the work are as



Cross-Sectional Diagram of Switchhouse and Power Station Showing Boilers and Piping.

basement is made inaccessible to any but authorized workmen, and by removing the high-tension apparatus from the power house itself into a confined space in a separate building the danger of coming in contact with high-tension apparatus is reduced to a minimum.

On the second floor are located the load dispatcher's office, the exciter battery with booster and switchboard, laboratory, storeroom, toilet rooms and the apparatus for the hot air heating and ventilating systems.

The arrangement of oil switches and connections is such that the apparatus belonging to one generator and three feeders form a unit which is entirely separated from the others by fireproof walls in the basement. All connections between oil switches and bus-bars are made with bare copper tubing 1 1/4 in. outside diameter, the construction being such that practically no insulators will be required. The busses are en-

tor cables will be used for connecting the generators with the oil switches.

Lights and Auxiliary Power.—About 1,000 incandescent and 36 arc lamps will be required for lighting the Port Morris power station, and 1,000 incandescent and 42 arc lamps for lighting the Yonkers power station. The amount of power required for operating auxiliary machinery equals 240-h.-p. alternating-current and 180-h.-p. direct-current at Port Morris, and 260-h.-p. alternating-current and 180-h.-p. direct-current at the Yonkers power station.

Load Dispatcher's Office.—In each power station a load dispatcher's office has been arranged for the proper distribution of power over the system and in order to give quick relief in case of accident or trouble. Only one of these will be in service at a time. Each load dispatcher's office will be equipped with a record board, indicating by means of lights and plugs, which gener-

follows: Foundations at Yonkers, Walter Butler; foundations at Port Morris, D. C. Weeks & Son; steelwork of both power stations, American Bridge Co.; superstructure at Yonkers, Butler Bros. Construction Co.; superstructure at Port Morris, Thompson-Starrett Co.; turbo-generators and complete switching equipment, General Electric Co.; exciter storage batteries, Electric Storage Battery Co.; boilers, Babcock & Wilcox Co.; piping, M. W. Kellogg & Co.; valves, Best Manufacturing Co.; stacks, Alphons-Custodis Chimney Construction Co.; condensers, Henry R. Worthington; feedwater heaters, Taunton Locomotive Mfg. Co.; boiler feed pumps, Epping-Carpenter Co.; flues, B. F. Hart, Jr. & Co.; coal and ash-handling apparatus, Exeter Machine Co.; mechanical stokers, Westinghouse Machine Co.; electric traveling cranes, Alfred Box Co.; light and power equipment, Thompson-Starrett Co.

The Combined Rubbish Destructor and Power Plant in New York.

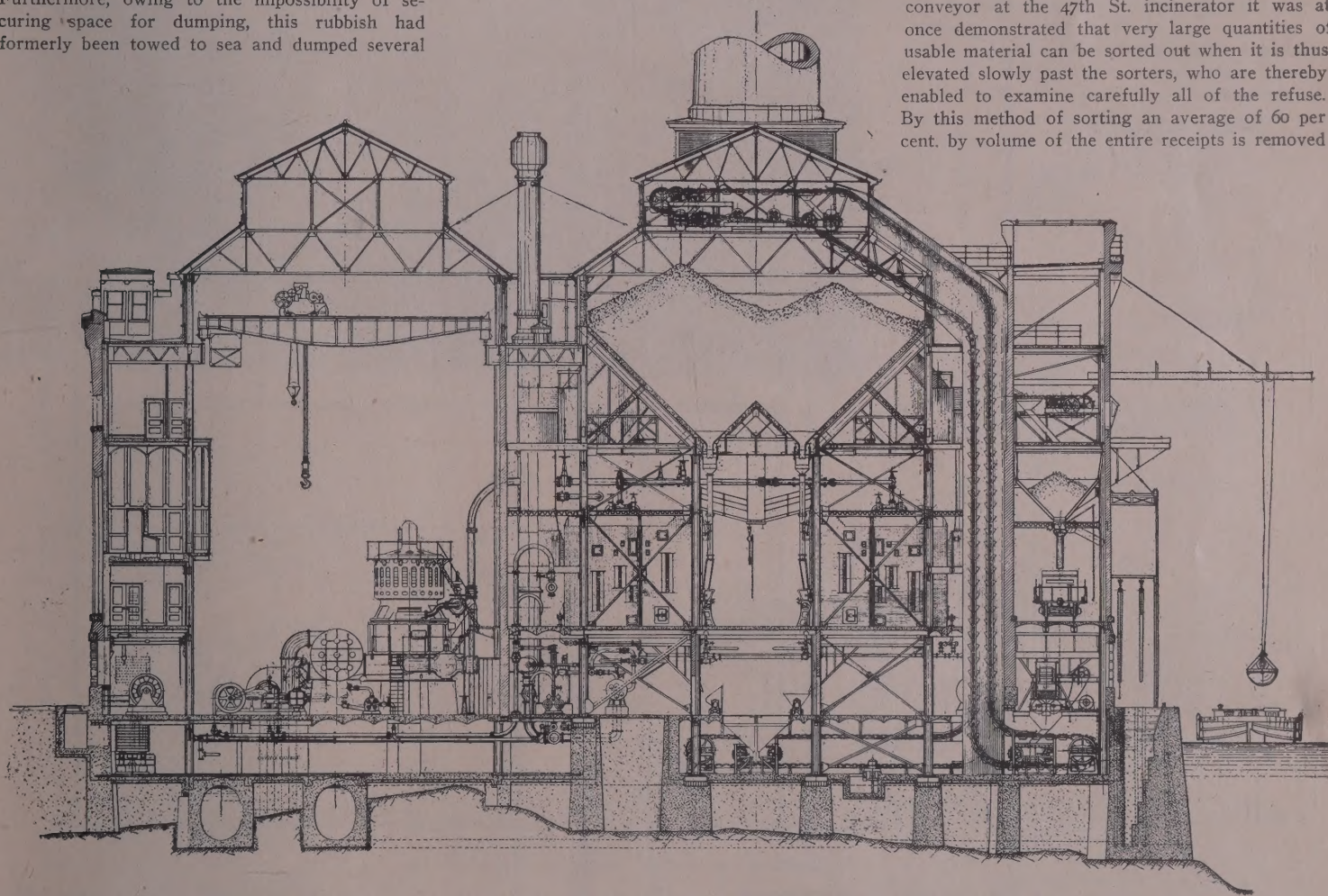
The first attempt on a large scale in this country to utilize the heat made available by burning rubbish has recently been begun in New York City. Many refuse destructors are in use abroad, with varying degrees of success, but the system has never been thoroughly tested in this country, owing, no doubt, to the availability near most large cities of dumping grounds for refuse. The practice in garbage and refuse disposal in New York provides for three classes of these materials, which are collected and hauled away separately, namely, ashes, garbage and rubbish; this is known as the "primary separation" which is required of all householders and occupants of buildings. The rubbish class includes waste paper, cardboard, discarded garments, wooden boxes, barrels, crates, mattresses, bedsprings, broken furniture and other bulky and unwieldy articles. The whole is very bulky and light in weight, and, consequently, its disposal is costly. Furthermore, owing to the impossibility of securing space for dumping, this rubbish had formerly been towed to sea and dumped several

and the results secured in its operation were discussed in the issue of Jan. 30, 1904.

Buildings.—The new combined incinerator and power plant of the Department of Street Cleaning and Bridges, which was briefly described in this journal on Jan. 30, 1904, is located beneath the new Williamsburg bridge, which, at a point near the river front, clears the street level by 125 ft. A plot, 158 x 166 ft. in size is occupied, embracing the full width of the bridge property, from Tompkins St. to East St. on the river front, so that excellent shipping facilities are provided. The incinerator building, which also contains the boiler equipment, is a one-story structure, 70 x 150 ft. in size, with steel roof trusses. There is a clear headroom of 25 ft. under the trusses. The front wall on the Delancey Slip side is of hard-burned red brick with buff brick facing, while the other walls are of Eureka vitrified hollow blocks, 12 in. thick, keyed together with steel reinforcing bars. At 16-ft. intervals in the side walls are 17 x 24-in. brick pilasters which carry the roof

holes on top of the furnaces. A considerable space is provided between the entering doors on either side of the room and the conveyor so that if the material is received faster than it can be elevated for proper sorting, the carts may be dumped on the floor until at a later time it may be raked on to the conveyor. At one side are inclines, the approach outside and exit within, by which wagons are driven directly to the charging platform above the furnaces.

Sorting Conveyor.—The sorting of the rubbish is a source of considerable revenue to the city, for valuable rubber, old garments, rags and various grades of paper are found in it. The sorting and removal of this material are let to a contractor, who keeps a force of workmen constantly picking over the refuse, all that is available being removed and packed for shipment. With the earlier methods of refuse disposal the revenue from this form of salvage was not large on account of the impossibility of properly going through all of the material received as it was dumped directly in cartloads from the docks into the scows, but with the installation of an apron conveyor at the 47th St. incinerator it was at once demonstrated that very large quantities of usable material can be sorted out when it is thus elevated slowly past the sorters, who are thereby enabled to examine carefully all of the refuse. By this method of sorting an average of 60 per cent. by volume of the entire receipts is removed



Cross-Sectional Diagram of New York Central Power Stations Showing Coal and Ash Handling Equipment.

miles off shore. This proved costly and, in addition, the greater part of the material floated ashore. Owing to the generally unsatisfactory results from the other principal method of disposal, namely, dumping upon low ground, an experiment probably suggested by earlier tests under Colonel Waring, was made about three years ago by the Department of Street Cleaning in the burning of the rubbish. A furnace was installed for the burning of all rubbish collected in one of the city districts by both the paper and rubbish carts and the street cleaning wagons, which has demonstrated the economy of the incineration of this material. This plant, which is one of the city's piers, was described in detail in *The Engineering Record* for April 19, 1902,

trusses independently of the block construction and also serve to furnish the necessary bracing for the block sections. The roof is of coal tar pitch and gravel on sheathing paper and roofing felt carried on 1-in. sheathing.

The building is divided into two rooms by a fire wall, 12 ft. high, extending crosswise through the middle, in front of which is the rubbish receiving and sorting department, and at the rear, the furnaces and the boiler equipment for steam generation. The receiving room has a paved floor on a level with the street so that the rubbish carts may drive in and dump directly on the floor for sorting or on an apron conveyor which has been installed to elevate the refuse and carry it over the fire wall to the charging

by the trimming contractor, for which the city receives about \$1.50 per ton.

The arrangement of the conveyor is shown in the illustrations. It is of the apron type of the Jeffrey Mfg. Co. and has a total length of 89 ft. from the lower end at the front of the building to the discharge point above the charging door on top of the furnace. The leaves of the conveyor are of 12-gauge steel, 6 in. in width with 6-in. side guards at each end, so that the whole forms a deep trough with 6-in. sides throughout; the leaves overlap so that the bottom is practically tight and the width of 4 ft. gives ample carrying capacity. Each leaf is riveted to a link of the malleable-iron roller driving chain, the rollers running on 3 x 2 x 5/16-in. angles which

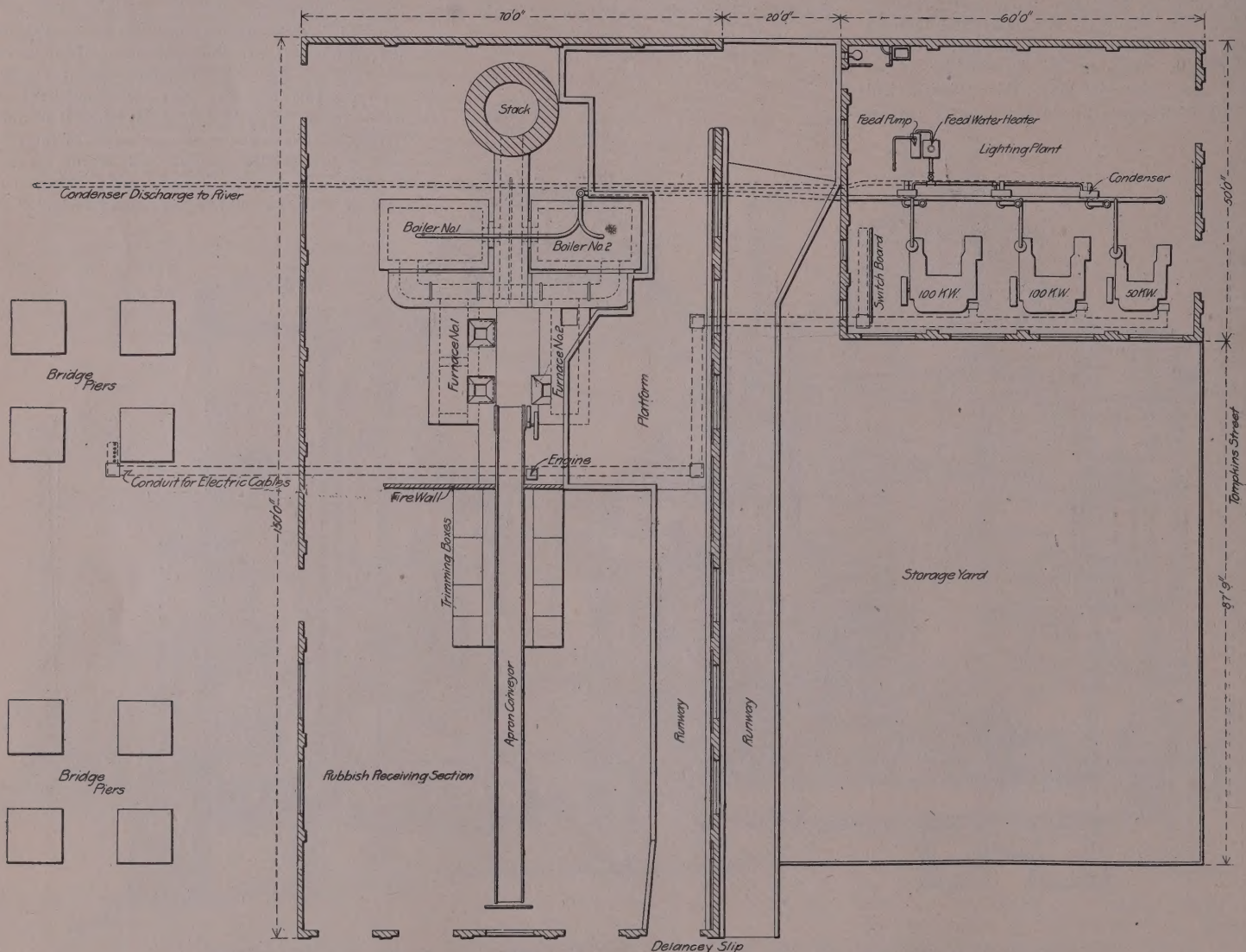
serve as rails. The conveyor is driven by a 7 x 10-in. vertical slide valve engine, taking steam from the boiler plant, which is connected to the conveyor drive through a double reduction gear giving it a working speed of about 70 ft. per minute. This engine is mounted on a platform above the division wall and is in charge of an engineer who overlooks the conveyor and trimmers and thus is enabled to operate without difficulty the conveyor at a speed most favorable for the trimming.

The trimmers stand on four small platforms on either side of the conveyor, adjacent to the division wall where the conveyor is about 10 ft. to 12 ft. above the floor. Between these platforms are light wooden bins into which the various classes of material are thrown and thus kept separated. The bins have openings at the bottom from which the sorted material is delivered to the floor for packing. The facilities for the

where there was sufficient space to permit a rise of 1 to 10; the wagons leave the platform on the inside ramp which has a fall of 1 to 6.

Destructors.—For the incineration of the 40 per cent. of useless refuse which the trimmers allow to pass them on the conveyor, there are two destructors. Furnace No. 1 has wrought-iron grates, and furnace No. 2 with plain cast-iron grates and both have large combustion chambers. The details of the furnace No. 1, first installed, are shown in the drawings. It occupies a floor area of 11 x 19½ ft. and stands 10 ft. 4 in. high. The side walls have 9 in. of common brick on the exterior, an air space of 4 in. and a 9-in. fire-brick lining. The interior has a 12-in. fire-brick arch, above which there is a filling of cinders to form a platform for the workmen who feed the furnace. The interior has a clear width of 4 ft. 7 in. and a clear height from middle of grate to top of arch of 6 ft. 2 in. The side walls

tapering from a thickness of ½ in. at the top, to 3/16 in. at the bottom edge; these are riveted up in sections of three each for convenience in handling and have ⅞-in. air spaces between bars. The heavy cast-iron stoke doors, slide in grooves at either edge, and are heavily counterweighted for ease of opening. The gases of combustion pass upward and over to a cross flue at the rear, which has two outlets, one leading to the boiler and the other a direct by-pass to the stack flue. The arches over the furnace as well as those forming the roofs of the cross and stack flues are made of special-form arch fire brick, while the stoking door holes are special-form interlocking blocks which tend to unify the construction. At the ends of both furnaces which face the division wall of the building there are large sliding doors, which open to an area of 3 x 4½ ft. in order to admit into the furnace large pieces of furniture, mattresses, and the like, without the



Plan of the New York City Rubbish Incinerator and Lighting Plant.

trimming do not take up much room, particularly as no storage of this saved material is permitted on account of the fire risk.

Charging Platform.—At the rear side of the building there is a platform, elevated 13 ft. above the floor, with incline approaches up which wagons are driven to deliver refuse directly into the charging holes if desired. This platform, which projects over the top of furnace No. 2, is of fireproof construction, having a steel frame and cement floor laid on Herculean flat-arch tile. The floor framing is carried on steel posts so located as not to interfere with the handling of the furnaces. The inclined approaches are of timber, that for loaded wagons being outside

have buckstays of 8-in. channels, tied across by 1½-in. rods; the feed holes are spanned by means of a special yoke construction. The whole structure rests on 18 in. of concrete.

The interior of the furnace is divided by a cross fire-brick wall, 18 in. thick, into two cells longitudinally, each of which is 8 ft. long inside. Each of these constitutes a complete furnace, having a feeding hole at the rear, two stoking doors at the front, two sets of grates and two ashpits. The feed hole is located so as to deliver the refuse to the grates over an incline at their rear; the hole is 24 in. square at the top and is fitted with a cast-iron facing for a tight-fitting cover. The grates are wrought-iron bars, 5-in. wide and

trouble of breaking them up into pieces.

The cross connecting flue is located approximately on the level of the furnace outlet and, in passing to the opening into the boiler setting, drops nearly 3 ft. in order to enter the boiler setting under the furnace arch. In passing to the stack flue it rises about 2 ft. This flue has on either side of the opening from the furnace, an opening in which a fire brick damper, 35 x 60 in. in area and 3 in. thick, is arranged to work up and down as required, for shutting off either one or both outlets from the flue. These dampers, which are of special blocks held together by ¾-in. iron supporting rods, are raised and lowered in the slots in the flue by means of triplex

chain blocks, mounted on light pipe frames. The stack flue is of similar construction, with fire brick lining, and is carried 25 ft. on a steel framework over to the stack. It has a barrier wall through the middle to prevent interference of draft between the furnaces.

The second furnace has been built on a somewhat different plan, to the designs of Mr. F. L. Stearns, of the Department of Street Cleaning, although it is of practically the same size and embodies similar details of air-cell sidewall and

Stack.—On account of the proximity to the Williamsburg bridge, a tall stack was necessary in order to deliver the waste gases of combustion well above the roadway. It was accordingly built 200 ft. high so that its top is some 75 ft. above the roadway of the approach at that point. It is a circular brick chimney built of hollow radial-molded block. It has a clear inside diameter of 4 ft. 6 in. at the top, and has a firebrick lining varying from 4 to 5½ in. in thickness to a height of 134 ft. above the foundation. An interesting

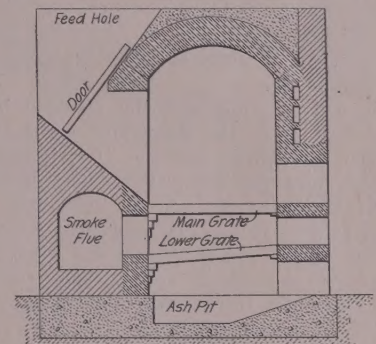
Operation.—Both of these furnaces, which have now been operated for several weeks by the Department of Street Cleaning, have proved satisfactory, the waste material burning rapidly and completely, with no smoke or offensive odor from the stack. A high temperature is generated continuously in the furnaces so that no trouble is experienced with the draft from the opening of the feed holes, the draft in fact, being in excess of the demands, on account of the tall stack. The furnaces are periodically stoked by means of long bars so as to turn over the burning material and sift out the ashes.

Practically no difficulty has been experienced, as anticipated, in periods of rainy weather when the refuse necessarily comes in wet. When the fire is once started by the use of boxes, barrels and other wooden refuse, the high heat thereby generated rapidly dries out the wet refuse as fast as it is charged into the furnace. When the fuel is wet the color of the smoke has a yellowish tinge, and when dry, a faint bluish-white color. The street sweepings are similarly burned with success, whether dry or wet; the latter are charged directly into the furnaces from the collecting wagons which drive to the charging platform by means of the inclines at the side of the incinerator building.

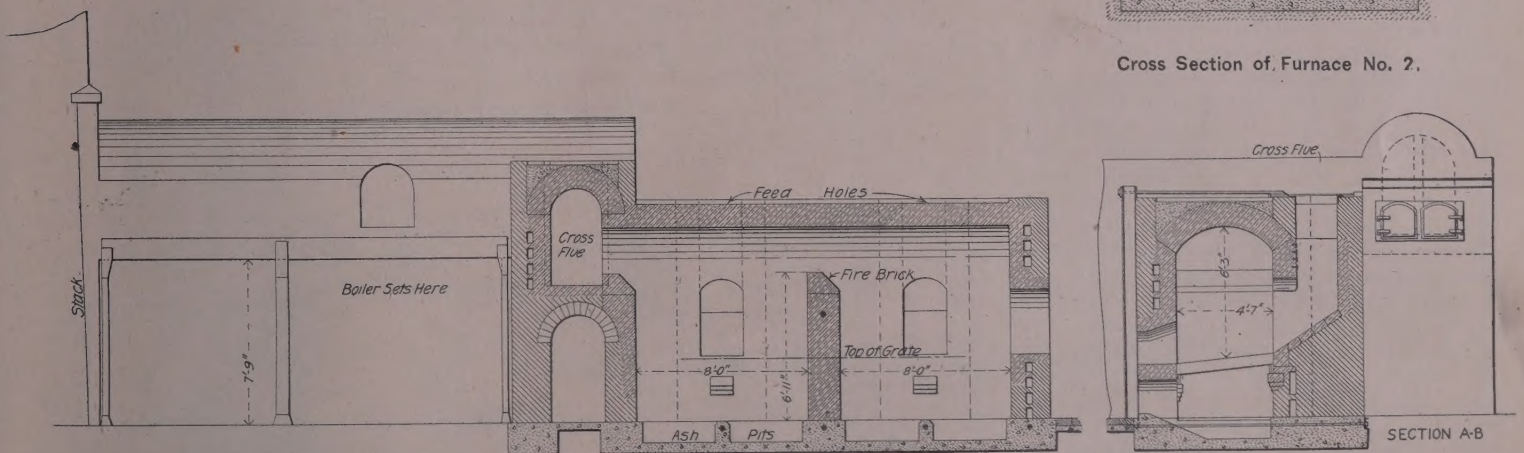
Electric Station.—The boilers and electrical generating plant, installed in connection with the incinerator are officially in charge of the Depart-



The Rubbish Receiving Section and Apron Conveyor Leading to the Furnaces.



Cross Section of Furnace No. 2.



Longitudinal and Cross Sections of Furnace No. 1.

top arch construction. A different arrangement of feed holes and grate has, however, been adopted and the furnace structure is approximately 18 in. higher over all. There is in this furnace only one side feed hole, the other hole being on the top of the furnace near the outlet end and about 3 ft. in area to facilitate the introduction of mattresses, bundles of refuse, boxes and barrels. The side feed hole is located near the end opposite the outlet, and there are two different sets of grates, one above the other, so that partially burned matter from the upper set of grates falls to the lower set, where the combustion is completed. The principal details of the second furnace are shown in the accompanying cross-section.

feature of the lining is the method of supporting it on a helical row of corbels on the inside face of the outer wall; in this way the lining is made to form a continuous helical band, 16½ ft. wide, winding upward on the inside, to which repairs can be easily made. The object of this helical arrangement is to prevent the outer column of the stack from cracking when exposed to sudden changes in temperature.

The foundation is of concrete extending to a depth of 14 ft. below the floor line, which is carried on piles driven down 25 to 30 ft. over an area 24 ft. square. The stack has an outside diameter of 15 ft. 10 in. at the base and 5 ft. 8 in. at the top. It was erected by M. W. Kellogg & Co.

ment of Bridges, the purpose being to light the Williamsburg bridge and possibly some adjacent parks and school buildings. A separate building was built adjoining the rear of the incinerator building. Care was taken in the allotment of space to keep the working forces of the two departments entirely separated at all times, the power plant work extending into the incinerator building only to the boiler fronts, beyond which the entire space is devoted to the refuse disposal. The separate building for the electric equipment is 50 x 60 ft. in size, with steel-frame construction and brick curtain walls, faced with buff-colored bricks, resembling the incinerator building very closely in general detail. This building has two bays, each 24 ft. wide. One has an

upper story for a storage battery, the lower floor being devoted to the generating equipment. The other bay, which is devoted to the auxiliaries and special purposes, extends the full height to the roof, 26 ft. The storage battery is to create a day load for the lighting plant. This structure is of fireproof construction, the roof being of reinforced cinder concrete with tar paper and gravel covering, the second floor is also of reinforced concrete and all floors have a cement finish. For handling machinery in the engine room there is installed a 5-ton hand-operated traveling crane of 22½ ft. span, which clears the floor by 14½ ft.

Boilers.—The boilers were necessarily located in close proximity to the furnaces and are accordingly in the incinerator building between the latter and the stack. They consist of two Stirling water-tube boilers, each of 200 h.-p. capacity, delivering steam at 150 lb. pressure. Each unit has 2,000 sq. ft. of heating surface consisting of 187 ¾-in. tubes. The three steam drums are each 12 ft. long and 36 in. in diameter. The mud drum is 10 ft. by 36 in. in size. Each boiler has a 2½-in. blow-off, with two valves in series, which delivers into the condenser overflow tunnel, and is fed through a 3-in. line from the feed pump in the other building. This feed line passes through an economizer coil in the stack flue connection before entering the boiler, which heats the feed to a high temperature. This coil consists of a manifold of 100 ft. of 2-in. brass pipe in a framework carried on a shelf opposite a door in the setting, so that, by by-passing the feed line and breaking two union joints, the economizer coil may be removed complete for cleaning and inspection.

The boilers, while normally operated by the waste heat from the incinerator furnaces, are provided with grates for coal, if it is necessary to shut down the incinerators. The grates are of the stationary cast-iron bar type with ½-in. spaces suitable for pea anthracite coal, and have an area of 6½ x 9 ft. Above the grate is the usual firebrick arch of the Stirling setting, to deflect the heat toward the tubes, below which the inlet flue from the incinerator enters.

Auxiliaries.—The auxiliaries are located in the adjacent building. There is a 7½ x 4½ x 6-in. Knowles duplex feed pump connected so as to deliver from either the city mains or the heater to the 3-in. feed line. This pump is controlled by a Kieley pump governor which maintains the pressure on the feed line automatically. Each boiler has a Penberthy auto-positive injector for emergency use, the supply being taken direct from the city mains. The feed-water heater is a Cochran open type of 400 h.-p. capacity, built by the Harrison Safety Boiler Works. It receives the exhaust of the feed and condenser pumps, and is fitted with a self-contained oil separator for the removal of entrained oil from the exhaust steam, and its supply of water is automatically controlled. The receiver capacity of the heater is about 130 gal. To it is also delivered the high-pressure steam-piping trap drips, and the drips from the heating system of the building.

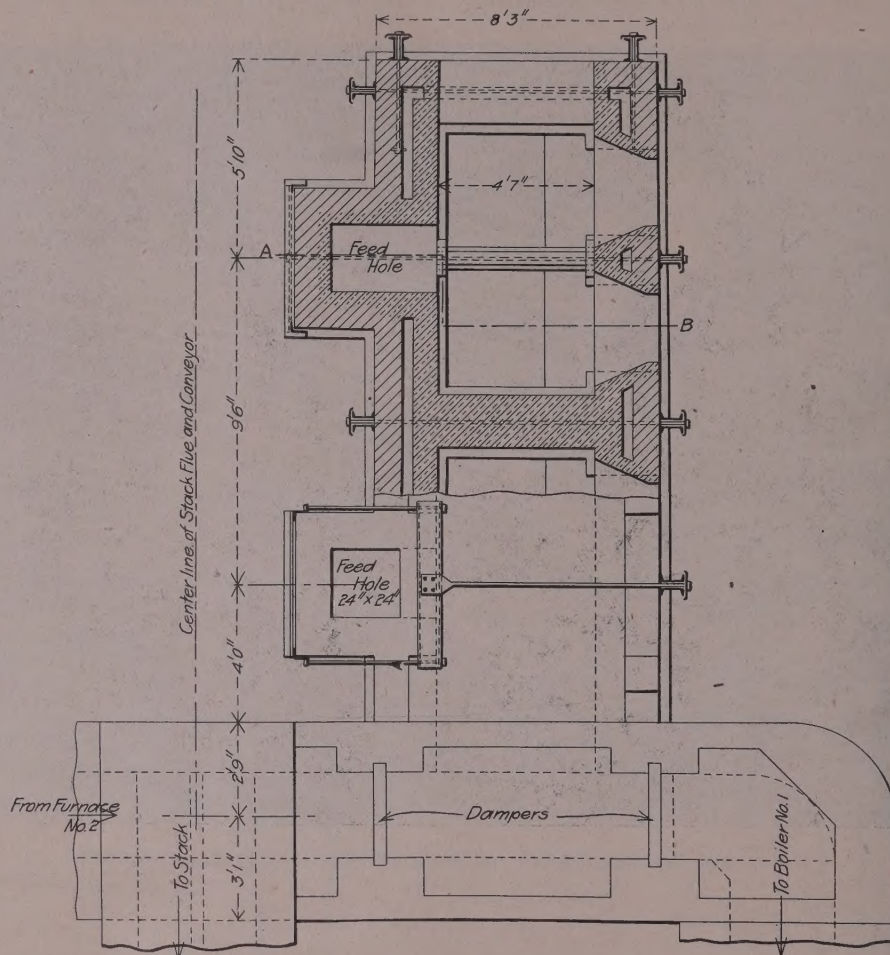
Piping.—The piping system is simple, consisting of a 7-in. line with 6-in. branches from each boiler, which leads across to the engine room. Here it is supported on brackets on the middle columns of the building, extending through to the engine branches, of which there are two of 4-in. and one of 2½-in. pipe. This line is graded toward the engine room and ends in a condensation pocket drained by a Kieley steam trap. All of the high-pressure piping is of steel pipe with Van Stone flanged joints with corrugated copper gaskets; expansion is provided for throughout by long-radius bends. Each engine branch has a Cochran separator immediately above the throttle valve. All the piping is covered with 85 per cent. magnesia sectional covering.

Engines.—There are two 100-kw. and one 50-

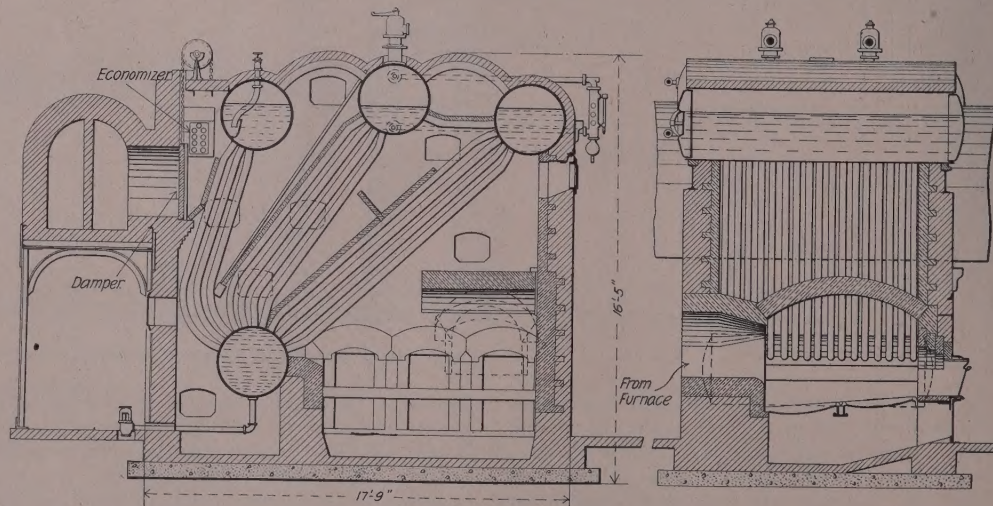
kw. direct-connected units, the former consisting of cross-compound horizontal Ideal engines of 155 h.-p. with generators between cranks, and the latter a similar cross-compound Ideal engine of 90 h.-p. all built by A. L. Ide & Sons, Springfield, Ill. The large engines have 12 and 20 x 12-in. cylinders and operate at 250 r.p.m., while the smaller unit with 9 and 16 x 10-in. cylinders runs at 300 r.p.m. These ratings are so taken as to permit an overload of 33⅓ per cent. to be car-

overflow being conducted to the river through an 8-in. discharge pipe. The wells have 12-in. casings and were driven 45 ft. below the floor line. It is contemplated, however, to connect the wells to a suction main, so as to draw the injection water from the river. The exhaust lines are connected to atmospheric relief lines of 6 and 5-in. spiral-ribbed steel pipe which lead to Sturtevant exhaust heads above the roof.

Provision has been made for the heating of the



Plan of Incinerator Furnace No. 1.



Details of Boiler and Setting.

ried continuously and the engines are guaranteed to regulate within 1 per cent. between half and full load.

The engines are operated condensing, for which there are three independent Blake vertical beam jet condensers, those for the larger engines having 7½ x 14½ x 8-in. and that for the smaller unit 6 x 12 x 8-in. cylinders. Injection water is now taken from three wells on the property, the

building in winter by steam from the vapor pipe of the feed-water heater through a 5-in. branch, as shown in the drawing, connected above the shut-off valve and below the back-pressure valve. The radiators are supplied on the two-pipe system and the returns lead back directly into the heater. For emergency use, there is a live steam connection to the heating system through a reducing valve.

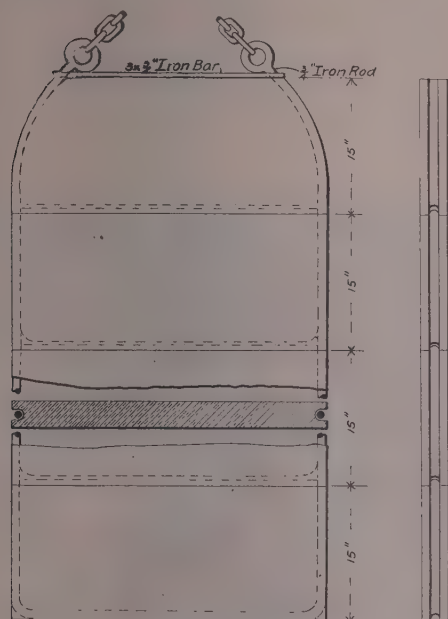
Electric Equipment.—The generators are multipolar, engine-type, direct-current machines, built by the Burke Electric Co., Erie, Pa. They are wound for 250 volts with special design for operating a 3-wire system with 125 volts on either side. Their ratings permit an overload capacity of 25 per cent. for two hours without a temperature increase of more than 15° F. above normal. The equalizing means for the three-wire system, are self-contained in the machines.

The electrical distribution is controlled on an eight-panel switchboard of marble on an angle-iron framework. The board contains three panels for the control of the generators, one totalizing panel, and four feeder panels. The latter provide seven distribution circuits, two for local lighting and five for lighting the bridge, which

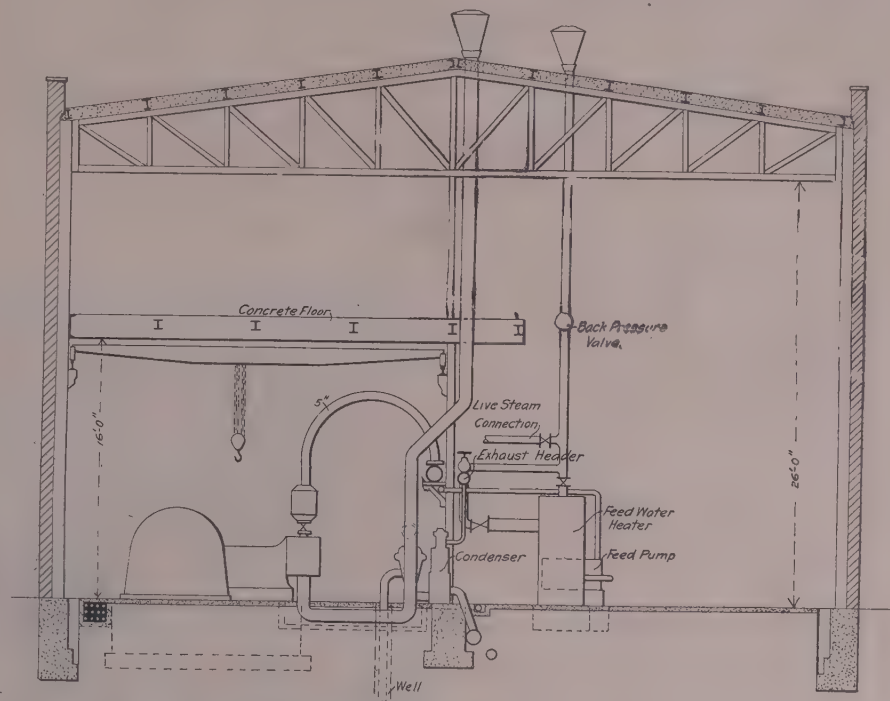
wooden refuse, mainly on account of the difficulty of clearing away the ashes. At the 47th St. incinerator it was found that over 60 lb. of refuse can easily be burned per square foot of grate area per hour under almost any conditions. At the new incinerator plant, with more favorable conditions, this figure can be considerably exceeded so that for the total grate area of the two furnaces of 146 sq. ft., there is no difficulty in disposing of 10,000 lb. per hour.

In the calculation of the capacity of boilers which should be installed for operation by these furnaces, the evaporative capacity of the rubbish was assumed at 1½ lb. of water per pound of combustible, which had been proved a safe figure

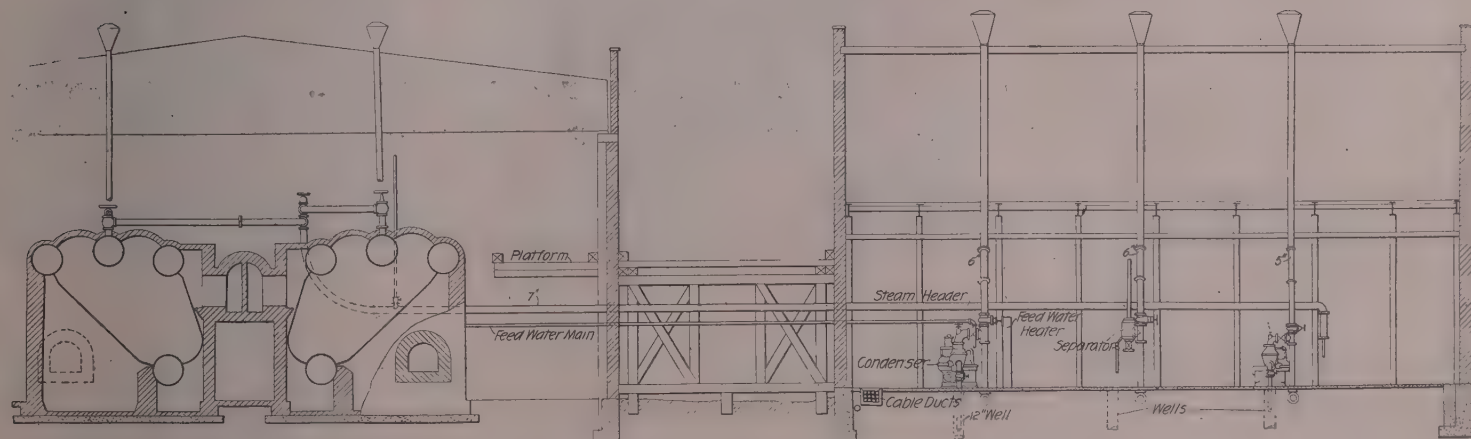
Costs.—A comparison of the relative costs of disposal of rubbish by towing to sea and dumping, and by the incinerator method, recently made by Mr. H. de B. Parsons, engineer in charge of the design, is of interest. The amount of this class of refuse collected per day in the districts served by the 47th St. incinerator was 728 cu. yd. In the following comparison this is assumed to be separated by the trimming contractor into 465 cu. yd. of salable material and 263 yd. of worthless refuse. The cost of dumping these 263 yd. at sea at the lowest rate yet secured, 20.42 cents, would be \$53.80. At the incinerator plant the daily fixed charges are: Labor, \$8.33; foreman, \$2.75; watchman, \$2.12; supplies and re-



Details of Cross Flue Damper.



Cross Section of Lighting Plant.



Details of the Boiler Arrangement and Piping System of the Lighting Plant.

is accomplished almost entirely by enclosed arc lamps connected on the multiple system. A blank space is left for additional distribution which the department may add later. All of the wiring and the switchboard were installed by Reis & O'Donovan, New York. All feeders, generator and switchboard connections have been carried underground in vitrified conduits.

Heat from Destructors.—The amount of rubbish that can be consumed per unit area of grate is, of course, a variable depending largely on the nature and condition of the material burned. Damp refuse does not burn as readily as the dry material, and paper does not burn as readily alone as when mixed with boxes, barrels and other

at the 47th St. incinerator, as well as in foreign plants. Thus, at this rate of evaporation, with the total grate area of 146 sq. ft. and a combustion rate of 60 lb. of rubbish per square foot per hour, the total evaporative capacity would be 13,140 lb. of water, which, in accordance with the usual method of boiler rating, is the equivalent of over 380 boiler horse-power. The boiler capacity most suitable for the installation was thus seen to be 400 h.-p., and accordingly each of the boilers is of 200 h.-p. nominal rating, although they have large overload capacities to take advantage of the extra amounts of heat that may become available under the more advantageous conditions of operation.

pairs, \$2.50; interest, \$2.24; total, \$17.94. The ashes amount to 3.1 per cent. of 263 yd., or 8.15 yd., which must be dumped at sea at a cost of at least \$1.66. The total charges for disposal by incineration are thus \$19.60, \$34.20 less than by dumping at sea.

At this rate the saving per year of 300 days over the old method of disposal will be \$10,260, which represents a percentage on the first cost of the incinerator furnace and building, roughly assumed at \$20,000, of 51.3 per cent. This figure also disregards the first cost of the conveyor and the boiler plant, as they both introduce additional economies, which necessarily alter the calculation. By means of the apron conveyor, the trimming

contractor is enabled to sort out from the refuse over 60 per cent. by volume, 35 per cent. by weight, which is marketable and brings back to the Department a revenue of \$1.50 per ton, whereas in the former method of disposal little or no opportunity was given the trimming contractor to sort over the material. The economies due to the boiler plant are of course all net gain.

The cost of the Williamsburg bridge plant was as follows: Rubbish incinerator, building, furnace No. 1, stack, etc., \$26,768; conveyor with engine, \$1,875; inclines for wagons, \$1,550; furnace No. 2 with flues, \$4,000; boilers and electrical generating plant, \$49,391. Total, \$83,584.

The plant was designed throughout by Mr. H. de B. Parsons, consulting engineer for the Street Cleaning and Bridge Departments of the City of New York. The Department of Street Cleaning has been represented by Commissioner Dr. John McGaw Woodbury and the Department of Bridges by Commissioner Geo. E. Best. The general contractors for the installation were the Ralph J. F. Gerstle Co.

Application of the Electric Motor to Refrigerating Machinery.

Interesting figures regarding the operation of small refrigerating machines by electric motors were presented by Mr. G. W. Goddard in a paper before the recent Lake Champlain meeting of the Association of Edison Illuminating Companies. Mr. Goddard has made a special study of small refrigerating machinery and its suitability for operation by motors and has discovered a large field for development in this direction. While artificial refrigeration has been extensively used in hotels, apartment houses and on shipboard, it has a promising future for dairies, markets, grocery stores, saloons, drug stores and residences, both on account of the simplification of the power problem rendered by the electric motor drive and the removal of the inevitable trouble of handling ice in ordinary refrigeration systems.

An interesting drug store installation was mentioned by Mr. Goddard in which refrigeration was required for three large soda fountains. The former conditions involved here were the usual ones of bringing ice into the store once or twice a day, breaking and placing it in the fountain at the top, resting on coiled $\frac{3}{8}$ -in. block tin pipes, through which flows the beverage from cylinders in the basement to the soda fountain spigots. The soda water should be as near 32° F. as possible, but it rarely can be maintained at a temperature below 40° to 45°, by reason of improper insulation, due to the door in the top of the fountain, warm air about the cylinders, and the gradual rise of temperature as the atmospheric temperature rises and the bulk of ice falls. The refrigeration system installed was what may be called sweet water circulating in the basement with a $7\frac{1}{2}$ -h.p. direct-current motor driving a three-ton refrigerating machine, which expands directly into an insulated tank filled with sweet water, the suction coil returning directly to the machine. From this tank a coil runs to one of the three fountains on the floor above, where it manifolds in the bottled goods compartment and so continues to the two others where, at the third, it rises and empties into the upper compartment, submerging the beverage coils and overflowing to the second fountain, and from there to the first, from which it returns to the tank, the circulation of the water being effected by a small rotary pump driven by a 1-h.p. motor. There is an additional chilled water circulation to a cold storage room in the basement, in which the temperature is maintained at 40° to 45° F. The plan of operation is to run the machine for a sufficient time to make enough ice on and about the expan-

sion coils in the water tank, with consequent low temperature in the fountain and cold storage room, during operative hours of the machine to maintain the desired temperature until the next day.

The advantages of this plant are obvious, prominent among which are avoidance of ice deliveries, with the attending slop and inconvenience, the time necessary to get the ice in condition and in place, constant temperature under control, and furnishing a temperature of 33° as compared with 40° to 45° with ice, securing dry air refrigeration in lower compartments of fountain, etc. The service rendered is equivalent to an ice consumption representing a cost of \$820.86, to which should be charged the time of two employees of the place for two hours each morning throughout the year, amounting to \$249.60, making the aggregate amount chargeable to refrigeration \$1,070.46. Since the installation of the refrigeration plant there has been added a cold storage room of 724 cu. ft. capacity, which would require half a ton of ice to maintain it at desired temperature, representing additional ice charge of \$468, making

rent motor. The entire outfit cost \$502, installed.

A test of an equipment installed in a large grocery store was described by Mr. Goddard. The plant embraced a 200-lb. machine, driven by a $\frac{1}{2}$ -h.p. direct-current motor, the entire machine equipment being enclosed in one end of the refrigerator, which measured over all 7 by 6 by 2 ft. The test extended from Oct. 5 to Nov. 2, 1904, inclusive, operating during the day from 5½ to 12½ hours, the average being 7.6 hours per day. The current consumption was from 1,700 to 4,600 watt-hours per day, the average being 3,675, the total consumption for the 25 days being 81.9 kilowatt-hours. The cost at 10 cents per kilowatt was \$8.19, or \$32.76 per day. Taking the average daily watt-hour consumption as a constant per annum, the cost for power per annum should not exceed \$102.21, while, as a matter of fact, the meter readings showed the actual use of current to amount to a considerably lower figure than the above.

The price of the installation, exclusive of the motor and wiring, was \$350, there having been no cost for repairs or additional charge for condens-



Construction View of the Boilers Showing Flue Connections, New York Rubbish Destructor.

the total cost chargeable to refrigeration of \$1,538.46. The account chargeable to the electrically driven refrigeration plant to furnish refrigeration for the above-named units is as follows: Power for one year (based on average of 11 months), \$579; interest 5 per cent. (on entire refrigeration plant, \$2,100), \$105; water for condensing purposes, \$9; depreciation and repairs, at 10 per cent., \$210; oil, waste, etc., \$50; total, \$953; difference in favor of electrically-driven machine, \$585.46.

A residence installation of interest was referred to in Mr. Goddard's paper which furnished refrigeration for a large three-compartment refrigerator 10 ft. wide by 7 ft. high by 2 ft. deep, usually full of varied food products. A galvanized-iron tank 4 in. in depth by 5 ft. high by 7 ft. in length, containing expansion coils submerged in a brine solution, was placed at the back and inside of the refrigerator, the expansion coils connecting with a 500-lb. refrigerating machine, located in the basement and driven by a 1-h.p. alternating-cur-

ring water, the rate being (for refrigeration-machine service) \$3 per ton of refrigeration per year. The former amount of ice used to effect refrigeration in the same sized refrigerator was 200 lb. per day, the rate for which was 30 cents per 100 lb., making the total cost of ice for the year \$187.20.

From the foregoing it will be evident that the cost of operating the small refrigeration machine by electrical power at current rates compares very favorably with that of ice refrigeration, while the saving in labor is an important factor. The amount of attention and repairs for good apparatus is reported to be an unimportant quantity.

POWDERED COAL FOR LOCOMOTIVE FUEL is being tested by the New York Central Railroad at its West Albany shops. The coal is ground very fine, and is fed to the furnace by means of an air jet for intimate mixture with the air necessary for combustion, an incandescent fire-brick arch maintaining ignition.

Transition Curves on the Southern Pacific R. R.

The use of transition curves to connect tangents with circular curves has now become almost universal on the principal railroad systems in this country, but a question is still raised among some engineers as to their practicability. The cubical parabola, transition spiral and various forms of tapering curves which are employed are objected to, either because of the difficulty of deriving the mathematical formulas used in applying them or on account of the inaccuracy of some forms when applied beyond certain limits. The Southern Pacific R. R. has used transition curves on all of its main line tracks for a number of years, and, according to Mr. William Hood, chief engineer of that road, their use would not be discontinued on any account. He considers that a track remains in line very much better where they are used, and that there are many other indications of their practical utility, chiefly the effect of the easement and superelevation of track on the rolling stock and passengers.

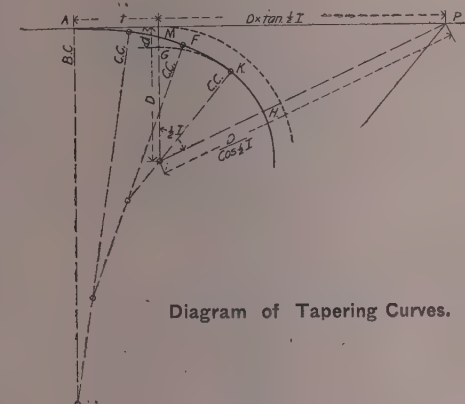


Diagram of Tapering Curves.

A part of the set for curves changing 1 deg. in 30 ft. is shown in the accompanying tables, which may be explained with the aid of the diagram. In the latter, *GKH* is a part of the main circular curve which is to be connected with the tangent, *AP*, by the tapering curve, *KFA*. Consider *BC* the beginning and *EC* the end of the whole curve; *CC* points of compound curve, both at the junction of the short curves in the easement and at the junction between the latter and the main curve. The intersection between the tangents to the main curve having been located in the usual manner and the angle of intersection, which is designated as *I*, having been determined, it is best to fix the *BC* and *EC* on tangent and the two *CC* points on the main curve. This may be done by proper tabular deflections and long chords, the *CC* points on the tapering curves being put in by successive deflections and short chord measurements.

The distance from the intersection point of the tangents to the *BC* and *EC* = $D \tan \frac{1}{2} I + I$. The distance from the middle of the main curve to the intersection of the tangents to it = $D \sec \frac{1}{2} I + d$, or $(D \div \cos \frac{1}{2} I)$ —radius of main curve. $D = d +$ radius of main curve, d being the distance between the main curve, when

intersection. Having located these points, the *CC* at the junction of the tapering curve and main curve may be located readily from the deflection angles and long chord values given in the tables. In first turning the total deflection angle from the *BC* to the *CC* of the main curve, it is considered worth while in the interest of accuracy of running to measure the long chord between these points, carefully establishing the *CC* from the taper to the main curve in this manner, instead of depending on the deflections of and measurements between the successive 30-ft. points. With the instrument at the *BC* the deflection angle between the tangent to the main curve and the long chord between that point and the *CC* at the junction between the taper curve and the main curve is given in Table II as 42 min. for a 4-deg. curve. The length of the corresponding long chord is given in Table I as 90 ft. The *CC* at the other end of the main curve may be located in a similar manner from the *EC*. The location of the remaining *CC* points is then simply a matter of turning the deflections for their 30-ft. chords as given in Table II, and measuring in the latter.

Should the main curve be other than one shown in the tables, for instance, a 6-deg., 30-min. curve, to be tapered with curves changing 1 deg. to each 30 ft., the taper curve may be run in to the *CC* at 6 deg., putting this *CC* in by tabular long chord and reflection. Then 15 ft. of 6-deg. curve may be run to the *CC* at 6 deg. 30 min., in all cases taking some convenient length of chord for the last compounding of the tapering curve, which length shall have, as nearly as may be, the same relation to the tabular chord length as the main curve bears to the adjacent tabular curves. Get corrected values of D and t by multiplying the cosine and sine of the total curvature up to the main curve by the difference of radii of main curve and of the last branch of the compound curve; subtract the cosine product from D and add the sine product to t , as

TABLE I.—PROPERTIES OF TAPERING CURVES CHANGING ONE DEGREE TO EACH 30 FEET.

Deg. of main curve.	D		t		Total curvature in tapering curve at each end of main curve.		d —less radius of main curve.		Long chord from <i>BC</i> to <i>CC</i> of main curve.	
	ft.	deg.	ft.	min.	deg.	min.	ft.	deg.	min.	ft.
2	2864.87	0	15.00	18	0	03	0.03	30.00		
3	1910.06	0	30.00	54	0	14	0.14	60.00		
4	1432.85	0	45.00	48	0	38	0.38	90.00		
5	1146.78	0	60.00	00	0	77	0.77	119.99		
6	956.40	0	74.99	4	0	30	1.36	149.96		
7	820.82	0	89.95	6	0	18	2.18	179.91		
8	719.62	0	104.90	8	0	24	3.28	209.81		
9	641.47	0	119.80	10	0	48	4.69	239.63		
10	579.59	0	134.66	13	0	30	6.45	269.35		

TABLE II.—DEFLECTION ANGLES FOR TAPERING CURVES CHANGING ONE DEGREE TO EACH 30 FEET.

Transit at	Deflections to									
	B.C. 1 deg. deg. min.	C.C. 2 deg. deg. min.	C.C. 3 deg. deg. min.	C.C. 4 deg. deg. min.	C.C. 5 deg. deg. min.	C.C. 6 deg. deg. min.	C.C. 7 deg. deg. min.	C.C. 8 deg. deg. min.	C.C. 9 deg. deg. min.	C.C. 10 deg. deg. min.
B.C. 1 deg.	0 09	0 09	0 22.5	0 42	1 07.5	1 39	2 16.5	3 00	3 49.5	4 45
C.C. 2 deg.	0 09	0 18	0 18	0 40.5	1 09	1 43.5	2 24	3 10.5	4 03	5 01.5
C.C. 3 deg.	0 31.5	0 18	0 18	0 27	0 58.5	1 36	2 19.5	3 09	4 04.5	5 06
C.C. 4 deg.	1 06	0 49.5	0 27	0 27	0 36	1 16.5	2 03	2 55.5	3 54	4 58.5
C.C. 5 deg.	1 52.5	1 33	1 07.5	0 36	0 45	0 45	1 34.5	2 39	3 51.5	4 59
C.C. 6 deg.	2 51	2 28.5	2 00	1 23.5	0 45	0 45	0 54	1 52.5	2 57	4 07.5
C.C. 7 deg.	4 01.5	3 36	3 04.5	2 27	1 43.5	0 54	1 03	2 10.5	3 24	4 39
C.C. 8 deg.	5 24	4 55.5	4 21	3 40.5	2 54	2 01.5	1 03	2 12	3 28.5	4 45
C.C. 9 deg.	6 58.5	6 27	5 49.5	5 06	4 16.5	3 21	2 19.5	1 12	2 21	3 39
C.C. 10 deg.	8 45	8 10.5	7 30	6 43.5	5 51	4 52.5	3 48	2 37.5	1 21	2 39

A tapering-curve form of easement, which is comparatively simple in its underlying principles and can be applied by any transitman who has sufficient knowledge of mathematics to be able to run circular curves, is employed by the engineering department of that road. These easements change degree of curvature each 30 ft. of length, the rate of change being made any desired amount. Tables giving the full properties of the curves and a brief explanation how to apply them are printed in convenient form for pasting in field books. One set of these tables is made for each rate of change of curvature in the tapering curves from 15 min. to each 30 ft., to 2 deg. 30 min. for each 15 ft. On lines where fast running is intended curves tapering 15 min. to each 30 ft. are almost invariably employed. All functions are computed for 1 radii of curves as calculated for the use of 50-ft. chords, as the engineering department of the Southern Pacific R. R. always uses 50-ft. chords in the measurement of plain curves and never uses 100-ft. chords, all radii being modified accordingly. Mr. Hood considers it very essential that anyone who can handle a transit at all on plain curve work shall have these tabulations in such shape as to work to them and have no difficulty in running in the easement curves without any computations whatever, other than for semi-tangents and the like.

easement curves are applied at each end, and a curve of the same degree, without easement curves, joining the same intersecting tangents. The values of D , d and t may be taken from the tables. Since the derivation of the formulas by which these values are obtained involves rather lengthy mathematical demonstrations the latter are omitted. It may be said, however, that these formulas are comparatively quite simple and can be readily developed by any one who has a working knowledge of the properties of ordinary circular curves. The tables of the deflection angles between the tangent to the main curve and the chords connecting the various *CC* points on the easement and main curves are arranged so the transit may be set at any point on the latter and the remaining points located by turning the proper deflections as given.

To briefly illustrate the application of the values given in the tables, consider a 4 deg. curve, with an intersection angle of 20 deg., to have an easement curve changing 2 deg. to each 30 ft. joining it with its tangents. The *BC* and *EC* of the whole curve, that is the main 4 deg. and the easement curves together, are both $D \tan \frac{1}{2} I + t$ from the intersection point of the tangents. From the table, $D = 1,432.85$ and $t = 45$, while the $\tan \frac{1}{2} I = 0.17633$. Substituting these values, *BC* and *EC* are found to be 297.65 ft. from the point of

taken from the table for the last branch of the compound curve.

Maximum grades for the different taper curves, corresponding to a range of grades on tangent are given in other tables accompanying those shown here. The maximum grade on the taper curves is the mean of the maximum grade on tangent and the maximum grade on the main curve to which the taper curve belongs. The latitude and departure of the *CC* points, referred to the tangent as a meridian and the *BC* as an origin, are also given in additional tables.

The simplicity of the theory connected with the development of the formulas from which the properties of these curves are obtained and the ease with which they may be located in the field are doubtless the leading features recommending their use. A careful study will show them to have considerable flexibility. There are no computations that can be made in reference to compounding or any intricate handling of circular curves that cannot be done with equal facility by this method. In close construction work like tunnels, wholly, or part on curves, with easement curves, or on reverse curves with easement curves, the method is as definite in reference to the location of any point in the tunnel exactly the same as it is located on the surface of the ground, as is possible with plain circular curves.

Tests of Reinforced Concrete Beams by the St. Paul Road.

The Chicago, Milwaukee & St. Paul Ry. uses a considerable amount of reinforced concrete in the covers of flat-top culverts, and has to design so many structures of this nature that its Department of Bridges and Buildings has been compelled to make a thorough study of existing experimental data of the strength of reinforced beams. It was found that the tests were fairly in accord, so far as bending-moment failure was concerned, but there was very little information concerning the liability to failure from excessive shearing stresses. In order to secure information of this character a number of beams were made and tested by the department. On Oct. 25 a valuable paper on these experiments was read before the Western Society of Engineers by Mr. J. J. Harding, from which the following notes are taken:

In designing the beams it was decided that but one percentage of reinforcement should be used, since only a limited number of tests could be made, and it was deemed advisable to make them as corroborative as practicable. The amount of reinforcement, about 0.75 per cent. of the area of the concrete above the center of the steel, was decided upon for reasons that will be discussed later. Ransome, Johnson, Kahn and plain round bars were used. In order to develop large unit shearing stresses, the ratio of the distance above the center of steel reinforcement to the length of the span was made as large as circumstances would permit, and still keep the size of the beam within the limits of actual construction. The length of span was fixed at 12 ft., which was about the limit of our testing machine. All of the beams were made 12 in. wide, and the depth was varied with the number and size of the bars, so as to keep the percentage of steel to concrete constant. Ten different sets of three beams each were made, as shown in the illustration.

A moderately wet mixture was used, made up of 1 part Atlas Portland cement, 2 parts of clean sand, and 5 parts of crushed limestone "crusher-run," under 2 in. The bottom surface, up to the top of the bars, was made of 1:2 mortar, as is our practice in actual construction. On account of the low temperature at the time the beams were constructed, the strength of the concrete was somewhat below the average of that generally used by the railway company. Six-in. cubes made from the same batch of concrete as was used to make beams 10 B and 10 C developed a compressive strength of 1,570 and 1,480 lb. per square inch respectively when four months old. Cubes from beams 1 A, 10 B and 8 C, made from the mortar only, developed 2,275, 1,930 and 1,720 lb. per square inch respectively at the same age.

The beams were broken when about four months old on a 200,000-lb. Olsen testing machine. All of the beams were broken on a 12-ft. clear span by loading at the one-third points, rollers being used at both the loading points and at the supports, to allow for any longitudinal movement.

Through the kindness of Prof. F. E. Turneaure, who loaned the company his extensometer apparatus, the longitudinal deformations of the upper and lower fibres were measured on 10 out of the 30 beams tested, one of each size.

Beams 1 A-B-C were reinforced with three 3/4-in. Ransome twisted bars, all placed horizontally and beams 2 A-B-C of similar dimensions and reinforcement except that the center bar was turned up at each end from a point 2 ft. 10 in. inside the points of support. An examination of these two sets of tests showed three interesting facts which might be called characteris-

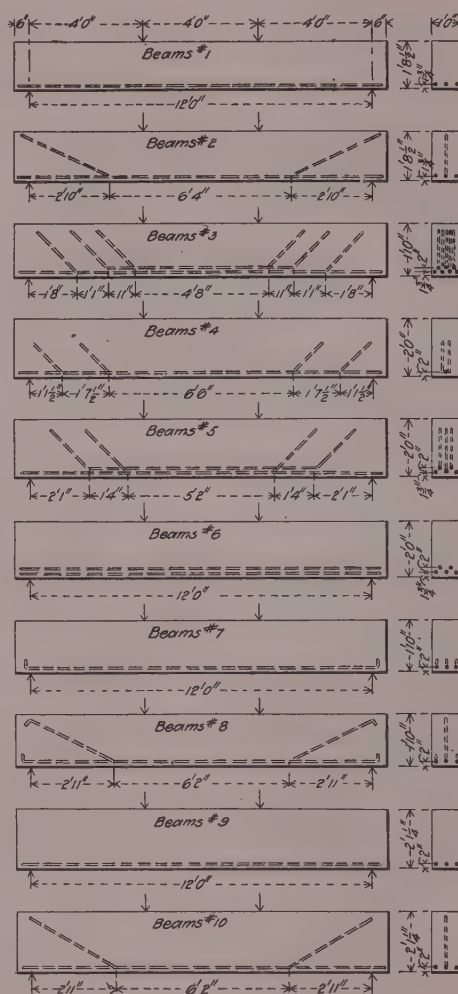
tics of large-sized beams reinforced in this manner.

1. The average ultimate strength of beams 2 A-B-C with diagonal reinforcement was 57 1/2 per cent. more than that developed in beams 1 A-B-C in which diagonal reinforcement was not used.

2. A much greater variation in strength was found in the beams having no diagonal reinforcement; beams 1 A-B-C varying by 40 per cent. in the ultimate bending moments while beams 2 A-B-C showed a variation of but 2 1/2 per cent.

3. The failure of beams 1 A-B-C occurred suddenly, while the diagonal reinforcement caused the failure crack to develop slowly in beams 2 A-B-C.

Beams 3 A-B-C were reinforced with seven 1/2-in. twisted bars, five of which are turned up



Diagrams of Reinforced Beams.

at their ends, thus giving to these beams a large amount of diagonal reinforcement. The principal reason for the design of this beam was to determine whether there was any advantage in using small bars and a large amount of diagonal reinforcement in place of larger bars and a smaller amount of diagonal reinforcement.

It was expected that these beams, reinforced as they were against failure at either end, would fail in tension or compression. As a matter of fact, only one of them, 3 C failed in this manner. The reasons for this are not difficult to determine, Mr. Harding states, after a careful study of the failure cracks. Beam 3 A failed suddenly in a crack which extended from one support to the nearest load, and apparently going directly through the diagonal reinforcing bars. After the beams were broken up it was discovered that all except the outer diagonal reinforcing bars had slipped down to the bottom of the beam

and the failure crack extended just across their upper ends.

Beam 3 B shows a failure that was undoubtedly due to the slipping or pulling out of the diagonal rods. In beam 3 C, the full strength of the concrete in compression was developed, crack No. 1 gradually opening up as the load was applied until the concrete finally crushed on top at the ultimate load. These beams developed an average strength 13 1/2 per cent. greater in proportion to their size than did beams 2 A-B-C, which was undoubtedly due to the additional reinforcement, aided perhaps by the higher elastic limit generally found in the half-inch bars. The character of the failure of beams 3 A and 3 B brings out clearly the necessity of extending shear bars as close up to the top of the beams as practicable, and also the necessity of having their ends securely anchored.

Beams 4 A-B-C reinforced with one 3/4 x 1 1/4-in. Kahn bar, all failed in a similar manner and at about the same loads. Tension cracks would gradually open up until the concrete failed in compression. It is probable that had a large percentage of reinforcement been used, or had these bars been made of steel having a high elastic limit, failure would have occurred near one end owing to the shortness of the diagonal prongs. A better design for this beam would perhaps have been to use two smaller bars with longer prongs, although the ultimate strength could not have been increased unless the opening up of the tension cracks was caused by the slipping of the bars, in which case two bars and longer prongs would have given a more secure anchorage.

Beams 5 A-B-C and 6 A-B-C furnish a comparison with corrugated bars similar to that obtained in beams 1 A-B-C and 2 A-B-C with twisted bars.

Beams 6 A-B-C reinforced with five 3/4-in. corrugated bars placed horizontally all failed suddenly in cracks extending from one support to the nearest load. Beams 5 A-B-C were of the same size as beams 6 A-B-C and similarly reinforced except that three of the bars were turned up at each end. Two of these beams, 5 B and 5 C developed the full strength of the concrete in compression while in the other, 5 A, the failure occurred slowly in a diagonal line at one end.

Beams 5 A-B-C with diagonal reinforcement gave an average ultimate strength 46 1/2 per cent. greater than that of beams 6 A-B-C without diagonal reinforcement. The maximum variation in ultimate strength was 12 per cent. in the former and 33 per cent. in the latter beams.

Beams 7 A-B-C and 8 A-B-C were reinforced with three 7/8-in. round rods, all horizontal in beam 7 and one turned up at each end in beam 8. An attempt was made to prevent slipping by bending three inches up 90 degrees at each end of these round rods. The same sudden diagonal failure occurred in beams 7 A-B-C that was characteristic of the other beams reinforced with horizontal bars only. The variation in ultimate strength was also large.

Beams 8 A-B-C differing from all others, failed in tension cracks, the rods apparently slipping before the full strength of the concrete in compression was developed, indicating that the three-inch bend at the ends was not a sufficient anchorage. That the rods did slip in one case was shown by breaking away the concrete at one end of a rod, where an opening of about 3/4 in. was found. Beams 8 A-B-C with diagonal reinforcement gave a 23 per cent. greater average ultimate strength than 7 A-B-C without diagonal reinforcement. The maximum variation in ultimate strength was 5 per cent. in the former and 42 per cent. in the latter beams.

In beams 9 A-B-C and 10 A-B-C, three 1-in. corrugated bars were used for reinforcement, all

horizontal in the former and with the center bar turned up at each end in the latter. All beams of both sets failed in a similar manner, diagonally from one support to the nearest load, except that in 10 C the diagonal bar seems to have pulled out the concrete shearing up around.

Beams 10 A-B-C with diagonal reinforcement gave an average ultimate strength 56 per cent. greater than the beams 9 A-B-C without diagonal reinforcement. The maximum variation in ultimate strength was 6 per cent. in the former and 20 per cent. in the latter beams. In these beams the diagonal reinforcement was clearly insufficient.

Results.—The accompanying table and diagram of the ten systems of reinforcement furnish a summary of the results. In designing the beams of sets 4, 5 and 6 it was intended to use the same percentage of steel as in the others, but a slight error was made in locating the center of gravity of the steel in sets 5 and 6, while in set 4 it was discovered after the tests had been made that

practical purposes on account of the large number of cracks which open up in the concrete. If this were not true, it would be possible to design beams based upon the ultimate strength of the steel instead of the elastic limit. By having a sufficient amount of diagonal reinforcement so as to prevent an end failure, and by using a very rich mixture of concrete, or placing reinforcing bars in the top of the beam so as to prevent a compression failure, a beam could be designed that would develop the full strength of the steel. Long before the steel failed, however, cracks would have been opened up in the concrete to such an extent as to have destroyed the beam for all practical purposes.

Adopted Formula.—In determining the values of $M \div bd^2$ an elastic limit of 54,000 lb. per square inch was used for the twisted and corrugated bars and of 35,000 lb. per square inch for the plain round and trussed rods. The effective depth is derived on the assumption that the stress strain diagram of the concrete in compression is ap-

ultimate strength of the beam will be raised without any increase in the amount of metal. By using a high elastic limit steel, however, the liability to diagonal failure is increased, so that greater care must be taken in the design than would be necessary if an equal amount of softer steel was used.

Mr. Harding has nothing to offer in the way of a method for determining the exact amount of diagonal reinforcement required in a given beam. The results of these tests, however, seem to show beyond a reasonable doubt that some reinforcement of this kind should be used at all times. Where the load to be sustained is light, and in addition a small percentage of steel is used, the unit shearing stresses are correspondingly small and there is but little danger of a diagonal failure. On the other hand, where large loads are to be sustained, as in railway structures, and where, in addition a large percentage of high elastic limit steel is used, the unit shearing stresses become excessive and the satisfactory reinforcing of the beam against diagonal failure becomes exceedingly difficult.

After a careful consideration of the results obtained from the above tests, Mr. Harding offers the following conclusions:

1. An amount of steel equal to about 0.75 per cent. of the concrete above the steel is as much as can be economically used in beams sustaining heavy loads, and subjected to large shearing stresses.

2. Diagonal reinforcement should be used at the ends of all large concrete beams, not only to develop the full strength of the beam, but to prevent a sudden failure.

3. Diagonal reinforcing bars should be brought well up to the top of the beam and securely anchored against slipping.

4. The use of small bars is preferable for several reasons. The elastic limit is higher, they give a better distribution of the stresses, and they offer a better opportunity to obtain a satisfactory diagonal reinforcement. Also they are much easier to handle, and bend in the field.

5. The use of bars larger than 1 in. is particularly objectionable both from a practical and a theoretical standpoint.

6. The ultimate strength of a reinforced concrete beam is reached when the steel has been stressed up to its elastic limit.

7. The location of the neutral axis varies with the amount of steel and the class of the concrete. With an amount of steel equal to about 0.75 per cent. of the area of the concrete, and with an average class of concrete, the distance from the neutral axis to the top of the beam at rupture is about one-third of the distance from the center of the steel to the top of the beam.

8. After obtaining the approximate location of the neutral axis it makes little difference whether the distance from the neutral axis to the center of the compressive area is taken as $2/3 Y$ as in the case of the triangular area, or $3/5 Y$, as for a parabolic area, the difference in the resulting resisting moment being less than 3 per cent.

9. Experimental methods are desirable for determining the position of the neutral axis, as it enables one to design a beam without making an assumption as to the modulus of elasticity of the concrete, which may easily vary 100 per cent. from its actual value. If the neutral axis has been determined by experiment, and a class of concrete used that will develop the elastic limit of the steel, the value of the modulus of elasticity of the concrete is not essential.

A NOVELTY IN COMMERCIAL ELECTRIC POWER SUPPLY has been introduced by the Rockford (Ill.) & Interurban Ry. Co., in a recent offer to supply electric current to farmers within one-half mile of the line, for power and lighting purposes.

TABLE OF RESULTS OF TESTS OF REINFORCED CONCRETE BEAMS; CHICAGO, MILWAUKEE & ST. PAUL RAILWAY.

No.	Reinforcement, percentage.	Moment in In.-lb. at failure.	Tension in Steel in Lbs. per Sq. In. from Moments.	Comp. in Concrete in Lbs. per Sq. In. from Extension.	Comp. in Concrete in Lbs. per Sq. In. from Moments.	Comp. in Concrete in Lbs. per Sq. In. from Compression.	Max. End. Shear, Lb.	Ave.	Max.	from Tests.	from Formula.	Remarks.
1 A	0.75	900,000	32,900	1,160	1,160	1,160	85	128	212.5	...	...	Quick diag. failure.
1 B	...	995,000	36,300	1,280	1,155	21,160	94	141	235.5	...	...	Quick diag. failure.
1 C	...	1,205,000	46,300	1,630	...	26,660	118	178	299.0	...	...	Quick diag. failure with hor. shear along bar.
Ave.	...	1,053,000	38,500	1,360	...	22,325	99	149	249.0	350.0	...	...
2 A	0.75	1,650,000	61,000	2,020	...	34,660	155	233	389.5	...	...	Slow diag. failure.
2 B	...	1,685,000	62,100	2,070	2,700	35,400	157	236	398.0	...	...	Slow diag. failure.
2 C	...	1,645,000	60,600	2,015	...	34,560	154	231	389.0	...	...	Slow diag. failure.
Ave.	...	1,660,000	61,200	2,035	...	34,875	155	233	392.0	350.0	...	...
3 A	0.75	2,225,000	75,000	2,910	...	46,775	193	290	452.0	...	...	Quick diag. failure.
3 B	...	1,915,000	64,200	2,500	2,090	40,275	173	260	425.0	...	...	Quick diag. fail; crack along bar
3 C	...	2,055,000	69,100	2,685	...	43,225	186	280	456.0	...	...	Slow comp. and tension failure.
Ave.	...	2,065,000	69,400	2,700	...	43,425	184	277	444.5	350.0	...	...
4 A	0.68	1,335,000	39,200	1,250	...	28,225	107	161	230.0	...	...	Tension failure; slight comp.
4 B	...	1,355,000	39,750	1,270	1,365	28,675	109	163	232.5	...	...	Tension failure; slight comp.
4 C	...	1,355,000	39,750	1,270	...	28,675	109	163	232.5	...	...	Tension failure; slight comp.
Ave.	...	1,348,300	39,600	1,265	...	28,525	108	162	232.0	205.0	...	...
5 A	0.72	2,255,000	64,300	2,545	...	47,425	184	276	407.5	...	...	Slow diagonal failure.
5 B	...	2,155,000	61,300	2,475	2,140	45,275	176	264	389.5	...	...	Slow compression failure.
5 C	...	2,425,000	69,000	2,730	...	50,925	197	296	438.0	...	...	Slow compression failure.
Ave.	...	2,278,300	64,900	2,580	...	47,875	186	272	412.0	334.0	...	...
6 A	0.72	1,655,000	48,000	1,670	...	34,925	136	205	299.0	...	...	Quick diagonal failure.
6 B	...	1,725,000	50,000	1,740	1,560	36,425	141	212	312.0	...	...	Quick diagonal failure.
6 C	...	1,295,000	37,500	1,310	...	27,425	107	160	234.5	...	...	Quick diagonal failure.
Ave.	...	1,558,300	45,200	1,570	...	32,925	128	192	202.0	334	...	...
7 A	0.75	1,180,000	37,800	1,295	...	24,775	103	155	243.5	...	...	Quick diagonal failure.
7 B	...	1,463,000	47,300	1,625	1,540	30,875	129	194	305.0	...	...	Quick diagonal failure.
7 C	...	1,025,000	33,100	1,130	...	21,775	91	131	213.0	...	...	Quick diagonal failure.
Ave.	...	1,219,000	39,400	1,350	...	25,810	108	162	254.0	226.0	...	...
8 A	0.75	1,305,000	48,300	1,705	...	31,775	132	199	313.5	...	...	Slow tension failure.
8 B	...	1,520,000	49,100	1,735	1,610	32,275	135	202	318.5	...	...	Slow tension failure.
8 C	...	1,460,000	48,800	1,650	...	30,875	129	193	303.5	...	...	Slow tension failure.
Ave.	...	1,498,000	48,100	1,675	...	31,640	132	198	312.0	226.0	...	...
9 A	0.75	1,658,500	39,800	1,290	...	35,025	126	182	255.0	...	...	Quick diagonal failure.
9 B	...	1,875,000	45,000	1,460	1,560	39,525	142	213	288.0	...	...	Quick diagonal failure.
9 C	...	1,565,000	37,500	1,215	...	33,025	119	178	241.0	...	...	Quick diagonal failure.
Ave.	...	1,699,500	40,750	1,320	...	35,860	129	183	261.0	350.0	...	...
10 A	0.75	2,585,000	61,750	2,060	...	54,375	195	293	397.0	...	...	Quick diagonal failure.
10 B	...	2,738,500	65,400	2,130	2,590	57,525	207	311	421.5	...	...	Quick diagonal failure.
10 C	...	2,625,000	62,800	2,100	...	55,025	198	297	404.0	...	...	Quick diagonal failure.
Ave.	...	2,649,500	63,300	2,110	...	55,640	200	300	407.5	350.0	...	...

the bar had an area of 1.79 sq. in. instead of 2 sq. in. as catalogued.

The positions of the neutral axis were obtained by plotting the deformations of the neutral axis of the B beams of each set. Averaging the results thus obtained the neutral axis was found to be at 34 per cent. of the distance from the top of the beam to the center of the steel reinforcement.

In calculating the stress in the steel and concrete from the bending moments, the center of pressure of the compressive axis was taken as three-fifths of the distance above the observed neutral axis. This is based on the assumption that the stress-strain diagram of concrete in compression closely approximate a parabola.

Taking only those beams which have diagonal reinforcement, and in which steel with a high elastic limit was used, it would seem from the tabulated results that the value of $M \div bd^2$ as derived from the formula mentioned below could be increased until more nearly equal to $M \div bd^2$ as determined by the tests. Although it is true that the values in the table represent the ultimate strength of the beams, still the beam, when under a much smaller load, is destroyed for all

proximately a parabola. With this assumption, the formula becomes:

$$M = \frac{F a^2 b}{S} (y_2 + 3/5 y_1)$$

where y_1 is 0.34 of the depth of the reinforcement from the top of the beam, y_2 is $1.94 y_1$, F is the elastic limit of steel, a^2 is the area of a steel bar, b is the width of the beam, and S is the horizontal distance between the bars. With the values suggested, this formula reduces to $M \div bd^2 = .350$.

The values used for the percentage of the steel reinforcement and the elastic limit of the steel were fixed partly by practical considerations. Experience in the design of covers for flat top culverts has shown that for a heavy railroad structure where beams 2 to 3 ft. thick are common, an amount of steel equal to about 0.75 per cent. of the area of concrete above the steel will give a spacing of bars about as close together as will allow of a safe transfer of stress from the concrete to the steel.

For the same reason it is advisable to use a steel of high elastic limit since by doing so the

Unusual Foundations at the Hoboken Terminal of the Lackawanna R. R.

The new passenger terminal station of the Delaware, Lackawanna & Western R. R. at Hoboken, N. J., is being erected on a site covered with about 20 ft. of water, below which is a layer of soft silt to a depth of 60 to 90 ft., with a stratum of sand and gravel between the silt and a ledge of solid rock that lies at a depth of 100 to 118 ft. The general design of the station building and an outline of the manner in which it was to have been constructed in sections to avoid interference with traffic were described in *The Engineering Record* April 29, 1905. The intention then was to remove only a part of the old station at a time and build the successive parts of the new one in its place, utilizing the old structure as much as practicable for handling traffic during the reconstruction. The complete destruction of the old terminal by fire on Aug. 7, however, required a change in the plans for carrying on the erection of the new terminal. It also required the construction of an entirely new arrangement of temporary terminal facilities for handling traffic. A temporary station and ferry slips have been built which permit the construction work to progress with probably no more interference with traffic than would have been occasioned by the plans necessarily adopted before the old terminal was destroyed.

The new terminal will have 14 tracks, 700 ft. long, covered in pairs by low, reinforced-concrete shelters, with 20-ft. reinforced-concrete platforms between each pair of tracks. Owing to the outer track on each side of the group being separate there will be 9 platforms. The tracks and platforms will cover a space 308.5x700.5 ft., which is nearly all on made ground that has been filled in for a number of years, but is not sufficiently stable to carry the platforms and shelters on spread footings. An ingenious method of driving at one operation the piles under the concrete piers on which the platforms will rest, and the forms for the piers, was described in *The Engineering Record* Sept. 30, 1905.

At one corner of the site for the new tracks an irregular space 250 ft. long by 80 to 120 ft. wide, back of the bulkhead line, had never been filled in, and was covered with 4 to 6 ft. of water at mean low tide, mean high tide being 5 ft. above that level. A pile dock carrying several car storage tracks had been built over this space and was first entirely removed. The old timber bulkhead which surrounded the area on the two land sides was next cut down 2 ft. below mean tide, or where it was in bad condition, removed and rebuilt to that elevation. Piles were then driven over the portion of the site of the tracks and platforms outside the line of this old bulkhead, cut off at 2 ft. below mean tide and capped. A heavy timber floor was placed over the caps, and the concrete piers which carry the platforms and the concrete footings for the cast-iron columns of the shelters built on it. A retaining wall was also built around the edges of this work on the two sides abutting on the water. The space enclosed by these walls and the old fill will be brought up with sand and cinders to the level of that portion of the latter on which the remainder of the tracks are to be laid.

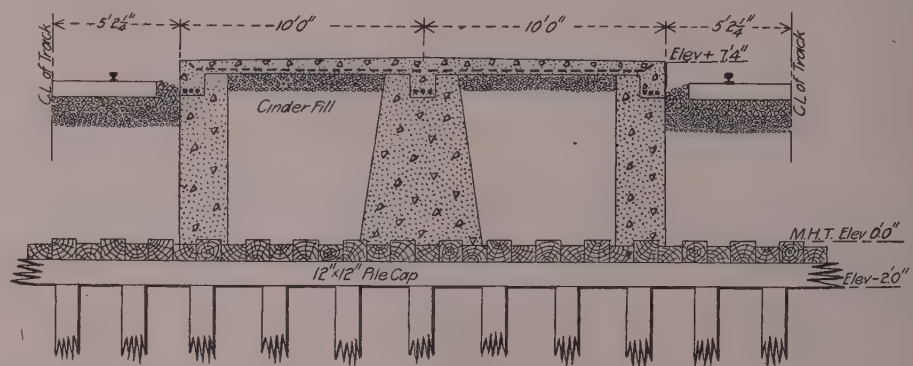
The platforms and shelters in all this area will be carried directly by their piers and footings which rest on the heavy timber floor and are entirely independent of the fill for support. The tracks, however, will be laid on the fill, which forms a cushion that will distribute the jar of the traffic and the braking effect of trains. As the floor on which the fill rests is tight it is considered that little settlement will occur, but in case there is a shrinkage the tracks can easily be surfaced up to their proper position.

The ground under the site of this work is much the same as that on which the station building will be erected and is covered by soft silt to a depth of 60 to 80 ft. The piles under the floor on which the fill and the concrete footings are placed are in transverse rows, 9 ft. on centers, with the piles in each row 3 ft. apart. The concrete piers for the platforms are 2 ft. square and 7 ft. high, being built large enough to prevent displacement when the fill is made. Those for each platform are in three longitudinal rows, one under each edge and one under the center line, with the piers in each row 9 ft. on centers. Every third pier in the central row is replaced by a footing for a cast-iron column of the shelters. These footings are 5 ft. square at the base, 7 ft. high and 3 ft. square at the top. The center lines of the transverse rows of piles are 4.5 ft. from the center line of the transverse row of piers on each side of it, and under each pier an extra pile was driven, while under each column footing 4 extra piles were driven. The single row of piles under the concrete retaining walls on the water sides of the work are on 3 ft. centers. A part of one of these walls is a continuation of the wall perpendicular to the line of tracks between the outer end of the latter and the station building, and will be covered so as to be protected from direct impact from the water side. It has been built 3 ft. wide at the bottom, vertical on its outer face and battered on its back face to a width of 2 ft. at the top. The other

which reaches 3 to 4 ft. above their bottoms. One 1-yd. and four ½-yd. Smith mixers are used in making the concrete for the platforms and all the substructures. Three of these are each set in a flat car at one end of a string of flat cars containing the concrete materials. These strings of cars are shifted as the work progresses. Runways are laid over the cars the length of each string and the materials hauled to the mixer in wheelbarrows. The concrete is dumped directly from the mixer into the forms in the work on the old fill. In work where the fill is being made runways are built out from the mixers and the concrete wheeled into place. The other two mixers are set up on the docks convenient to the off-shore work on the building footings.

A triangular-shaped dock, 350 ft. long, 110 ft. wide at the in-shore end and tapering to a heavy daulphin of piles at the outer end, joins an extended track and its platform on one side and one of the ferry slips of the new terminal on the other. This work is intended chiefly to accommodate boats plying between the government immigrant station on Ellis Island and an immigrant station recently constructed along the site of this outer track as a part of the terminal improvements. This dock is built on transverse rows of piles, 9 ft. on centers, the piles in the rows being 5 ft. apart.

The concrete retaining wall along the end of the tracks and platforms is on the outer line of permanent construction. The station building will



Cross-Section of Platform Showing Cinder Fill on Timber Floor.

wall is partially along the edge of a dock where steamers will land; the remainder is along the water line of a dock on which tracks for car storage will be built. The more exposed part will be built 4 ft. wide at the base and 3 ft. wide at the top; the other part will be 3.5 ft. wide at the base and 2.5 ft. wide on top, the front face of all the walls being vertical.

The first work in reconstruction on the track and platform site was to remove the old dock and drive the piles which carry the heavy timber floor. The piles were then sawed off under water at the required height by a 48-in. circular saw on a vertical shaft run by a hoisting engine on a platform on a track laid on temporary pile bents. The caps over the piles are 12x12-in. timbers drift-bolted to the transverse rows. The floor over these caps consists of 8x12 and 12x12 in. timbers, laid longitudinally with the platforms, the two sizes being alternated to form a corrugated floor surface which will prevent the concrete footings from slipping on it. The top of the pile caps is at mean low tide. They and the timbers in the floor were all floated in position as needed during high water, then spiked in place at low tide.

The forms for the piers, column footings and retaining walls are 2-in. lumber dressed on one side. They are built in sections on land and floated into place, then at low tide they are erected on the timber floor and well anchored to the latter by toenailing at the base and by braces above that to prevent their displacement at high tide,

be constructed entirely outside of this wall on 280 concrete footings of various sizes, carried on heavy timber grillages resting on piles driven 80 to 90 ft. through the silt into the sand over the rock. The load on these footings varies from 20 to 460 tons, and they are carried by 6 to 40 piles. The piles are cut off at 2.5 ft. below mean tide and capped with 12x12-in. timbers. A solid floor of 12x12-in. timbers, with two or more 8x12-in. timbers, is placed over the caps. The concrete of the footings is laid on this grillage and carried up with vertical sides to 1.5 ft. above mean tide. At this elevation it is stepped off 12 in. on all four sides of the footing and then built up to 3.15 ft. above mean tide, or 0.65 ft. above mean high tide, which is just about the extreme tide level. The bases of the steel columns of the buildings will rest immediately on the concrete. The grillages of the column footings are tied together by 12x12-in. timbers in such a manner as to make the whole timber framework continuous. Wherever the span of the timbers extending from one footing to another exceeds 20 ft. a pile is added at the middle of the span to furnish additional stability.

About 50 of the footings are completed and the erection of the steel framework of the station building has been commenced. The piles for nearly half of all the building column footings have been driven, and it is expected that concrete for this portion of them will be placed before the season closes. The construction of these footings outside the bulkhead line has been at-

tended with considerable difficulty. A few of the piles were driven by drivers mounted on platforms running on tracks laid on the temporary pile bents. Most of them, however, have been driven by four floating drivers with extra long leads. The greater part of the piles are over 80 ft. long. They drive extremely easy at the start, but as their points approach the sand under the silt they resist driving sufficiently to give good supporting power. They are sawed off by the mounted circular saw used on other parts of the work, and the cap and grillage timbers drift-bolted in place during low water. The holes in these timbers for the drift bolts are made by bits driven by compressed air, which is supplied by a compressor plant mounted on a scow. The concrete forms are securely anchored to the grillage timbers. The concrete is wheeled to them from the mixers on plank runways laid on temporary bents built up from the timbers.

The concrete for all this work is being mixed very wet in the proportions of 1 of Atlas Portland cement, 2 of sand and 3 of broken stone, with the dust screened out, that will pass through a 2-in. screen. The forms on the concrete in the filled ground are removed in 48 hours after the concrete is placed, if necessary. Those on the concrete exposed directly to the water will be left on all winter to insure protection to their surfaces against ice until they are completely set. The water around the site is very heavily charged with sewage, but it has been determined from other structures in the vicinity that concrete laid in it, when properly mixed and placed and when made sufficiently rich, has not been affected by the presence of the sewage in two years.

The foundation work on the terminal will involve the driving of more than 13,000 piles for permanent construction, while a large amount of temporary piling is required to carry on the various parts of the work. The piles in docks which

measured out from that line by triangulation.

The foundation work on the terminal is being carried on by the regular forces of the Delaware, Lackawanna & Western R. R., Mr. L. Bush, chief engineer. Mr. J. E. Snell, superintendent of the department of buildings and docks, has general supervision of the work, which is under the immediate direction of Mr. F. L. Wheaton, assistant

Gravel Roads in Ontario.

In the Province of Ontario, where there are about 60,000 miles of country roads maintained by township and county councils, there has been a great improvement in highway construction and maintenance since a provincial highway department was organized to aid in the work. A large



Part of the Forms for Concrete Retaining Walls and Column Footings, Looking In-Shore.



A Portion of the Concrete Footings for Station Building Columns, Looking Off-Shore.

have been built for at least 30 years and are now being removed to make room for the new work are apparently as sound as when driven, it being considered the sewage has prevented the action of the teredo. The accurate placing of each of the piles in the new work has been attended with special difficulty, since the reference base line had to be established back of the outer line of permanent construction and all centers off shore

engineer. The plans for the foundation and all of the substructure work were developed under the direction of Mr. G. T. Hand, assistant engineer.

THE FIFTH ATLANTIC CABLE has recently been completed by the Commercial Cable Co. from Canso, Nova Scotia, to Waterville, Ireland, a distance of nearly 2,500 miles.

amount of gravel road-building has been done, and from the experience gained in this way Mr. A. W. Campbell, commissioner in charge of the department, has recently prepared the following suggestions concerning the selection and handling of gravel.

The best gravel in Ontario for road purposes is obtained from banks and ridges, and consists of clean pieces up to $1\frac{1}{2}$ in. in size, with enough fine stuff to make a compact mass. The face of a good pit is a solid mass of pebbles from the size of a marble up to $1\frac{1}{2}$ in., and such a bank which will keep an upright face after the spring thaw is fairly certain to furnish good material. The defects of gravel are usually an excess of sand, large stones, clay, loam and earthy matter, and the management of a pit should be such that these materials are removed with the least expense. It is a good plan to strip the sod and earth from the top of the bank, so that they will not fall to the bottom, and the loading of the teams must be done carefully so that nothing of the sort is carted to the road.

If there are only a few large stones, these can be raked out as the gravel is spread on the road, and sometimes it may be desirable to have a man at the pit who will remove them as the gravel is shoveled into the carts. Where there are many large stones it is best to run the gravel through a crusher and then screen the product. If the gravel contains fine sand and earth, it must be screened, and care should be taken in laying out the screens to avoid all unnecessary lifting of the material.

The common claim that a proof of the good quality of gravel is its ability to pack readily under traffic is not entirely correct, Mr. Campbell points out, for this property may indicate the presence of too much clay and earth, which will cause the road to become muddy or slushy in the wet season. The stone is what is needed, although it is sometimes said that screened gravel

is undesirable because it packs slowly. It is true that such gravel consolidates more slowly than the unscreened pit product, but, on the other hand, the bond is much better when finally obtained.

The cost of gravel roads can be materially reduced in many cases, Mr. Campbell believes, by attention to the way in which the teaming is done. Care should be taken that the teams move in a regular order and are not allowed to crowd into a small pit. A definite number of loads, each of a given quantity, should be specified as a day's work and payment made accordingly. As large loads as possible should be required, and Mr. Campbell is emphatic on the economy which results from the use of wagons made so as to dump their contents rapidly. These are particularly useful when screenings are used for a top coat, for they distribute their loads so uniformly that labor in spreading is saved. Where the work is sufficiently extensive a number of such wagons hauled by a traction wagon may prove the most economical outfit.

In building gravel roads where a scraper is available, Mr. Campbell advises first rounding up the natural soil to a slightly smaller crown than the finished road will have. The scraper is then passed over one side of the center, cutting off the top and turning the loosened dirt to

Corrugated Concrete Foundation Piles.

The 100 x 129-ft. Lattemann Building at St. Edwards and Sycamore Streets, Brooklyn, is six stories high and is intended to be used as a shoe factory. It is of slow-burning construction with brick walls, wooden columns and heavy wooden floors, and is being built under a contract awarded to Mr. Frank B. Gilbreth. The site is a dry fill of from 15 to 20 ft. on a deep dense stratum of hardpan, the surface of which is about at high tide level and the ordinary level of ground water in that vicinity. Thirty preliminary test holes were sunk on the site with a 1-in. jet pipe and a 3-in. casing pipe, which were jetted down to an average depth of 10 ft. and then driven to hard bottom. From the indications of these tests and a careful examination and study of the conditions, it was decided that the character of the soil was such that wooden pile foundations should not be used on account of danger from decay. Estimates for masonry foundations carried down to hardpan and of concrete pile foundations driven from the surface of the ground were in favor of the latter, and they were adopted and a contract for them was awarded to the Corrugated Concrete Pile Co., 34 West 26th St., New York.

There are in the foundation about 480 piles,

forced by a conical frustum of Clinton wire cloth which clears the corrugations about $\frac{3}{4}$ in. It is made from a 17½-ft. by 62-in. sheet with 3 x 12-in. meshes of No. 3 and No. 10 wires, the large wires running longitudinally and intended chiefly to reinforce the pile against bending stresses to which it is subjected during handling before being driven.

At the site molds were provided with each side made from a 10 x 2-in. spruce plank 18 ft. long, dressed to the required dimensions and having a 2½-in. half round wooden strip with $\frac{1}{4}$ -in. cut from the flat side, nailed to the center of the piece inside to make the corrugation.

Concrete mixed in a Stanley mixer, manufactured by the United Concrete Machinery Co., and made 1:2:4 with Atlas Portland cement and 1 in. broken stone was delivered to the molds by wheelbarrows, care being taken to work it thoroughly with bars so as to fill all cavities and air spaces and flush the mortar to the surface. It was made so wet that it readily passed through the meshes of the reinforcement. After about 24 to 48 hours the mold was stripped from the pile and used again, and the pile was kept sprinkled daily for two weeks, after which it was considered ready for driving.

The piles were driven by two ordinary machines with 3,200-lb. hammers and leads about 30 ft.



Laying Heavy Timber Floor on Pile Caps; Part of the Piers and Column Footings, Floored-Over Area, Hoboken Terminal, Lackawanna R. R.

the side. This is repeated on the other side, leaving a flat surface in the center of the roadway, along each side of which is a shoulder of loose earth, forming a shallow trench. The gravel is spread over this trench and consolidated with a heavy roller, and the loose dirt at the sides is leveled off to conform to the shape of the roadway.

Old gravel roads are commonly flat, in ridges, with square shoulders at the edge of the ditches. In this case the better plan, Mr. Campbell believes, is to cut off these shoulders, throwing the loosened earth outward. The ditches are usually very wide and flat, the road having been graded by drawing the earth out of the ditches with a scraper, so that the shoulders thus turned outward merely widen the graded roadway without interfering with the drain. If, however, these ditches are sharp and deep, the loosened earth may drop down so as to obstruct the water, in which case it will have to be thrown across the drain to the roadside by hand, a proceeding seldom necessary. Usually a sufficient depth of gravel is found on these roads, requiring only that the center should be raised by cutting off the sides. After this is done as above described, a light coating of clean gravel to fill the ruts and depressions and restore the crown will make a good road.

most of which are loaded to a maximum of 25 tons each and are arranged in groups of four under the walls and under the column piers. They are capped at about the level of the ground with 4 x 4-ft. concrete footings 20 in. thick, surmounted with stone pedestals and enclosed by the back-filling. All the footings are reinforced by crossed $\frac{3}{4}$ -in. rods, and in several places there are special longer footings supported on several groups of piles. These footings have special steel reinforcement and are virtually distributing or cantilever girders.

The piles are of a new type of reinforced concrete, recently invented by Mr. Frank B. Gilbreth, and were cast at the site before being driven. They are special in the design and in the methods of construction and driving, the former being intended to afford extra bearing value in soft ground by increased skin friction and the latter to insure uniformity and preserve the integrity of the pile. For this work they were all made 18 ft. long with an octagonal cross-section 16 in. in diameter at the top and 11 in. at the bottom. In the middle of each side there is a corrugation whose section is the segment of a circle $2\frac{1}{2}$ in. in diameter which extends from the bottom end to within 6 in. of the top. In the axis of the pile there is a circular jet hole 4 in. in diameter at the top and 2 in. at the bottom. The concrete is rein-

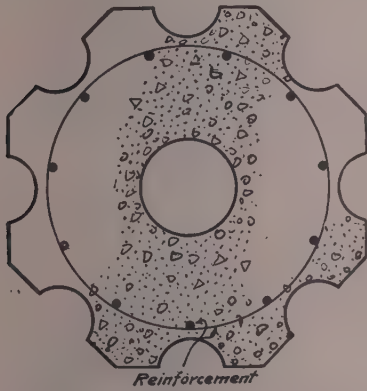
forced by a line from the pile driver and hoisted up by one end like a wooden pile, and in all cases endured this treatment without injury. The pile was seated and the hydraulic pipe and nozzle inserted through its axial hole so as to facilitate driving by the hammer. The piles were driven to refusal in the hardpan, the heads usually projecting a few inches above the surface of the ground and not being injured by the driving.

In order to reduce the shattering effect of the hammer impact on the concrete, the piles were driven with a cap which consisted of a riveted steel plate sleeve 3 ft. long fitted over the top of the pile with about $\frac{1}{4}$ -in. clearance and overlapping about 3 in. Several layers of burlap were placed in the bottom of the sleeve and then it was filled nearly to the top with short pieces of old rubber hose to form a cushion on which was set a solid oak plunger about 2 ft. long, projecting above the top of the sleeve to receive the blows of the hammer. For an experiment the cushion cap was replaced by a 2-in. oak plank, and after it had received several blows of the hammer the pile appeared uninjured. The piles were driven at the rate of from 7 to 18 daily per driver and the work, which commenced the last of August, was practically completed about the middle of September.

Steel Details in the Alterations of the Judge Building.

The Judge Building, at 110-112 Fifth Ave., New York, was originally a seven-story commercial building with self-supporting brick walls, circular cast-iron interior columns and rolled floorbeams and girders. Some recent improvements designed and supervised by Maynicke & Franke, architects, included the addition of four stories above the former roof level and the removal of nearly all of a heavy longitudinal interior wall which carried the ends of the floorbeams. This wall was taken out without disturbing the tenants, and steel columns were substituted in its place to carry the floor load which it formerly sustained. It was calculated that the old footings were adequate to sustain the increased column loads from the additional stories, but the upper tiers of the cast-iron columns were not strong enough. The problems of connecting the new to the old columns and supporting the former without overloading the latter, and of replacing the interior wall by columns without danger to the building or unnecessarily disturbing the tenants, were difficult and delicate, and the methods of solution are ingenious and were successfully executed.

The first story on one side of the partition wall



Typical Cross Section of Corrugated Pile.

was used as a show room and had costly decorations and fittings on the wall; it was not permissible to injure that wall surface in any manner and the wall was therefore allowed to remain up to the second floor and all work was done without entering the show room. The wall footings as a whole were adequate for the new loads, but, as these loads are concentrated and the lower part of the wall could not be removed, it was impracticable to provide for the distribution of the new loads over the full length of them. Detached new footings were therefore provided at column points, where holes were cut through the old footings and caissons were sunk about 10 ft. below the cellar floor to the solid rock. On them foundation piers were built carrying grillages of transverse beams much longer than the thickness of the old footings, and just below the level of the cellar floor.

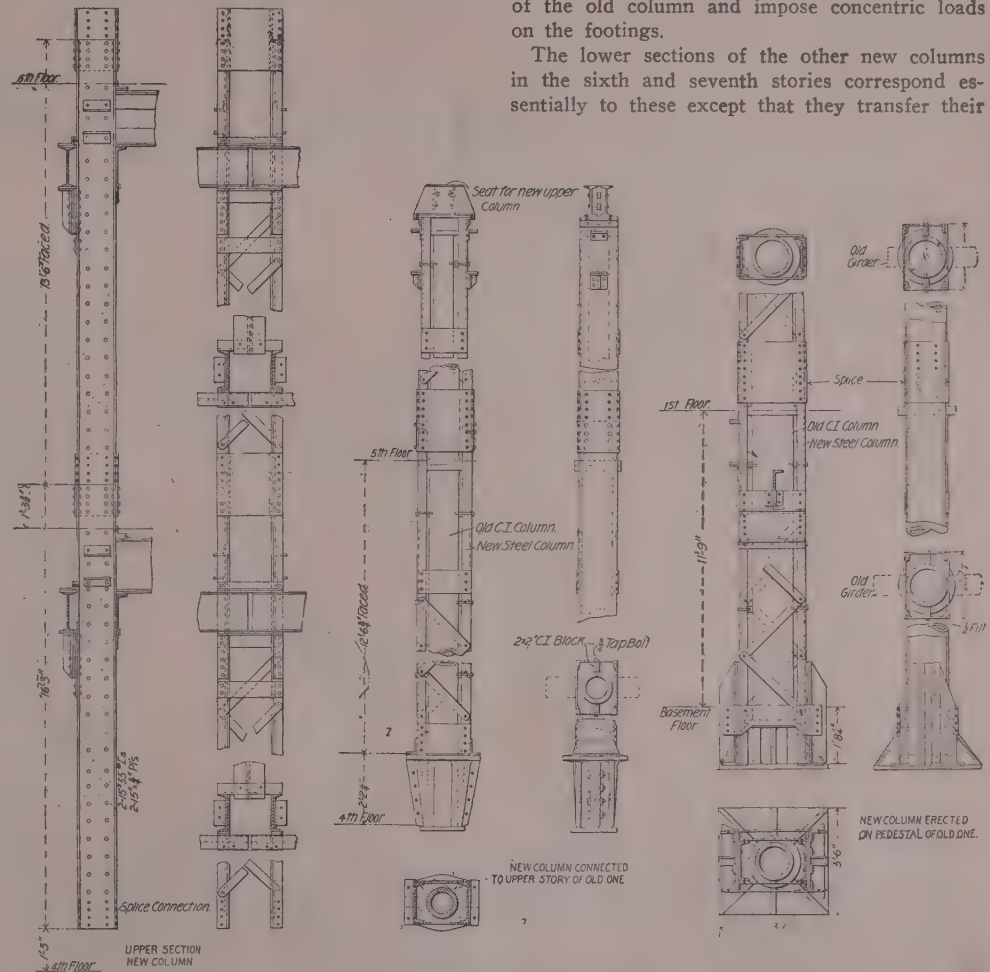
Above these new footings chases were cut in the wall, on the face opposite the show room, and in them seven new steel columns were erected. Up to the seventh floor, the columns were made in two-story lengths with rectangular cross-sections consisting of two channels, latticed with their reinforced webs at right angles to the plane of the wall. The columns were spliced with two web and two flange cover-plates at each joint, and shelf angles with reinforced horizontal flanges were riveted across the column channels to receive new I-beam girders, parallel to the wall, which carry on their top flanges the ends of the old floorbeams, formerly resting on templates in the wall.

Above the first story, the wall was pierced in each story by wide arches, between which the columns were located. The columns were erected in the wall chases and these arches having been filled solid with temporary masonry, the wall was removed from the top, downwards. As fast as it was taken away to the levels of the beam seats of the successive tiers, the new girders were set in the clearances thus provided on their column seats and the ends of the old floorbeams were transferred from the old wall to the girders and another story of the wall was removed, another girder set, and so on.

In most cases the lower stories of the old cast-iron columns were competent to sustain the weight of the new stories, as before stated, but in three cases the old columns were not con-

column webs and cast-iron filler blocks, and tapped into the cast-iron shell. The column splices are made with four web and flange cover-plates just above the splices of the cast-iron columns. The new columns are seated on the extended pedestals of the old cast-iron columns. The new column has no base plate, but each of its channels is reinforced at the lower end by a pair of thick gusset plates, riveted to the web and projecting beyond the flanges. These plates are stiffened with four vertical angles and their lower ends are faced and have a single horizontal flange, bearing on the base plate of the pedestal. The flange angle and gusset plates are cut to fit between the vertical reinforcing webs of the pedestal and give the largest bearings attainable, which are symmetrical on both sides of the old column and impose concentric loads on the footings.

The lower sections of the other new columns in the sixth and seventh stories correspond essentially to these except that they transfer their



New Columns Carrying Upper Floors.

sidered strong enough to carry the additional floors at any point, so the new steel columns, in all cases on the center lines of the old columns were carried down independently of them to their pedestals, but received no loads below the tops of the old columns which continued to carry their original loads. This was accomplished by building the new columns, up to the seventh floor, in longitudinal halves, shipped separately from the shops, assembled together on both sides of the old column so as to enclose it, and riveting the parts of the column together in the field to form a single new column concentric with the old column, but independent of it. The columns had an ordinary rectangular cross-section, made of two channels having their flanges united by tie plates and lattice bars which were special only in that all their rivets were field driven. The tie plates and lattice bars were spaced so as to clear the old girders, which pass between the flanges to rest on cast brackets of ordinary construction. Near the upper and lower end of each old cast-iron column the new column is centered on it by a pair of set screws passing through the

loads to the upper parts of the old cast-iron columns. They are made in halves, field-riveted together around the old columns so as to clear the old floor-girder connections and have deep I-beam caps on the upper end of the eighth story sections to receive the feet of the columns in the new stories and transmit their loads to the old columns at the sixth floor. At the sixth floor the feet of the new columns are seated on cast pedestals made in the form of split ribbed sleeves. The upper end of the pedestal has a planed horizontal flange. The lower end has no flange, but the web is planed to fit accurately on the flange of the old cast-iron column joint.

There are in all ten of these columns, six of the type where the new column encloses the full length of the old one, and seven new steel columns in the plane of the old wall. All of them were successfully erected and adjusted to take their share of the loads without materially interrupting the business of the different tenants of the building. Mr. Luke A. Burke was the mason contractor, and the steel work was furnished by J. B. & J. M. Cornell.

The Broadway Outfall Sewer, Borough of the Bronx, New York.

The Broadway outfall sewer has been built to carry the combined sewage and storm water flow from about 2,300 acres of the watershed of a small stream, called Tibbetts Brook, in the north-west part of the borough of the Bronx, New York City, to an outlet in the Harlem River. It is nearly 3 miles long and extends from 192d St. and the river to the northern boundary line of the city. The outfall discharges into the Harlem River about $1\frac{1}{2}$ miles from the mouth of that stream in the Hudson River, which is 13 miles from the mouth of the latter in upper New York Bay. The total watershed of Tibbetts Brook is 3,640 acres, but provision has been made for handling the flow from that portion in the city only, the remainder of the watershed being under the control of another municipality. A considerable part of the lower end of the district served by the sewer consists of tidal flats, but beyond this low ground the land rises somewhat abruptly from the valley of the stream and most of the drainage area is made up of rolling country. Van Cortland Park, which covers an area of 1,100 acres, is nearly all within the sewer district and as the remainder of the district has not been improved to any extent the sewage flow at present is small. It is considered, however, that the area in the district outside the park will be entirely built up eventually, and the outfall has been designed for that condition.

The upper part of the outfall from its junction with the Tibbetts Brook at the corner of the park to the north city line is an ordinary brick sewer, varying from a 3-ft. circular section at the city line, to a horseshoe-shaped section, capable of carrying a flow equal to that carried by a 7-ft. 3-in. circular sewer, just above the junction with the stream. This portion of the sewer involves no unusual features in its design, and as it was built in fairly good ground, little difficulty was experienced in its construction. From the lower end of this work to the outlet in the Harlem River the outfall consists of a twin horseshoe-shaped sewer, the combined cross-section of which varies from an equivalent to that of a 14-ft. circular sewer at the beginning, to that of a 16-ft. 6-in. circular sewer at the end. The sewer from its intersection with Tibbetts Brook to the outlet is built on a heavy concrete cradle, with the concrete on piles where necessary.

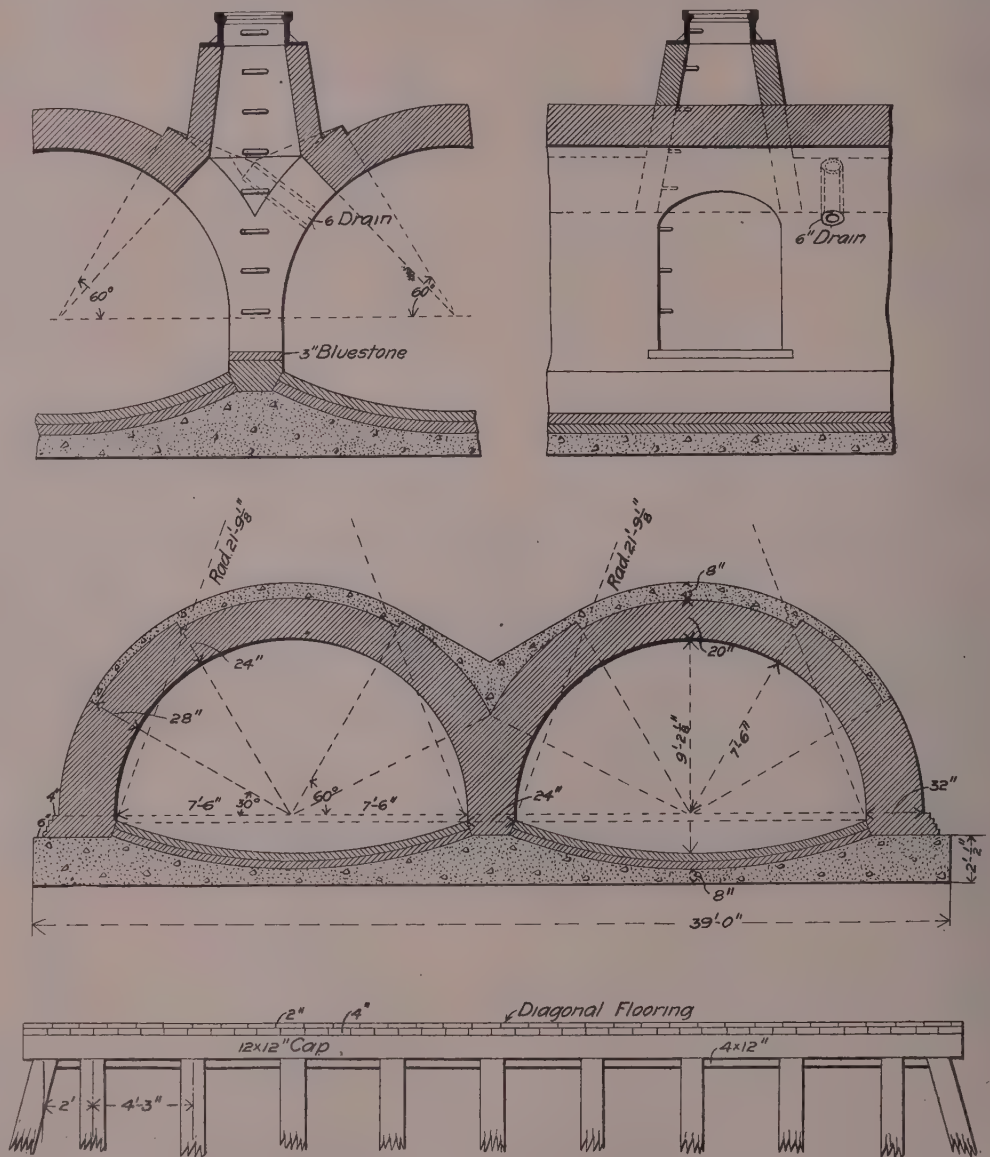
The natural ground surface along this section of the sewer is largely below the top of the sewer arches and in many places below their inverts, so the twin horseshoe-shaped section was adopted instead of a single large circular one, to gain headroom. Even with this type of construction a large amount of filling had to be made after the sewers were finished, in order to provide the minimum established covering of 4 ft. over the top of the arches. The outfall is laid its entire length in city streets, and an embankment, 30 ft. wide on top and with 1 to 1 slopes on its sides, built up over it. This embankment reaches a maximum height of about 12 ft. above the natural ground surface, with an average height of about 10 ft. in the low sections. It is to be paved on top with macadam and its slopes are riprapped with 2 ft. of broken stone.

A cross-section of the largest part of the twin sewer is shown in one of the accompanying illustrations, the cross-sections at other points being practically the same, except in dimensions. On good foundation the concrete cradle on which the whole structure is built is 2 ft. thick under the arches and 8 in. thick under the sewer inverts. The thickness of the concrete is increased over poor foundations to suit the conditions, while in specially bad places the concrete is laid on a pile and timber footing, the details of which are also shown in the illustration of the cross-section of

the twin sewer. The sewer inverts are built of one ring of hard-burned red brick laid on the concrete and overlaid with a ring of vitrified brick; the arches are built of hard-burned red brick, all the brickwork being laid in Portland cement mortar. A protecting layer of concrete is placed on the extrados of the arches and keyed into the brickwork as shown. The concrete in all parts of the work was mixed wet in the proportions of 1 of Portland cement, 2 of sand and 5 of broken stone.

One branch of the twin sewer is bulkheaded at its upper end just above the intersection with the stream, and the other branch is continued in the small sewer to the north city line. The stream will be carried for the present under the twin

The stream was carried across the line of the outfall in a temporary channel during the construction of the culvert and the work on the latter carried on in a cofferdam. The culvert is 60 x 80 ft. in plan, its greatest dimension being transverse to the line of the sewer. The bed of the stream at its site is made up of soft silt, which was removed to the underlying sand and gravel and a floor of 12 x 12-in. timbers resting on 12 x 12-in. sills, built on the latter. The ring stones and the bench walls of the culvert arches, to the springing line of the latter, 4 ft. above the floor, are ashlar rock-faced granite masonry. The spandrel walls are rubble masonry. The arches, which have a span of 6 ft. and a rise of 3 ft. above the 4-ft. bench walls are built of three rings of brick,



Cross-Sections of Twin Sewer, Showing Manhole and Standard Construction.

sewer through four 6 x 7-ft. openings in a heavy masonry culvert, the cradle of the sewer resting directly on the culvert. On the park side of the sewer above this culvert is a swamp of about 40 acres, included in the park area, which will probably be flooded to make a lake by closing up the openings in the culvert and diverting the flow from the stream into the sewer at an elevation several feet above the top of the culvert arches. The discharge of the stream is already somewhat equalized by a lake in the park, but the formation of this new lake would provide much greater equalization. When the stream, which has a tidal flow of 6 ft., has been diverted into the sewer, considerable areas of low ground in its bed between the culvert and the Harlem River can be reclaimed.

with a filling of concrete between them on which the inverts of the sewers rest directly. The floor of the arches is 8 ft. below mean high tide, so they discharge part of the tidal flow under a head of about a foot.

For 400 ft. on the north side and 100 ft. on the south side of this culvert, the excavation for the outfall, was in marshy ground and had to be carried 1 to 7 ft. below the sewer sub-grade before a suitable foundation was secured. This extra excavation was filled in with broken stone, and the thickness of the concrete cradle increased 12 to 18 in. Good natural foundation was secured from the south end of the low ground for about 1,200 ft. At the end of this work a rock ledge is near the sub-grade of the sewer and extends along its center line for some distance, sloping trans-

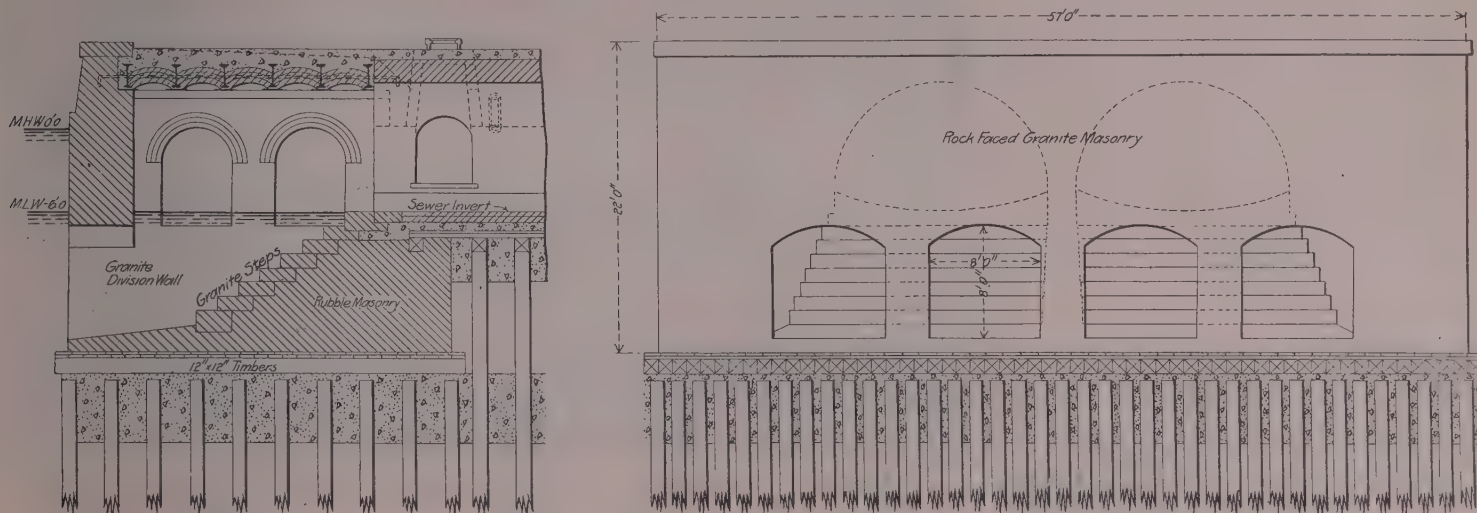
versely to it. On one side this ledge drops away to a depth of 2 to 7 ft. and was covered with muck and silt. This material was removed and the trench filled nearly to subgrade with rubble masonry, the remainder being built up solid with concrete to the sewer inverts. The line crosses the two main-line tracks of the New York Central & Hudson River R. R. in this part of the work. The base of rail in these tracks is a little below the top of the sewer arches and the original plan was to build under the tracks with a special section having a flat concrete roof, heavily reinforced, and a considerably greater width than the regular section. The railroad company is constructing a cutoff some distance south of this line, over which the greater part of the traffic will be diverted, and the present tracks will probably be abandoned. Temporary connections will therefore be made under this crossing.

of the tidal flats along the Harlem River. These flats are for the most part made up of soft black mud and silt overlying rock or glacial drift, so the construction of the outfall across them was exceptionally difficult. At the upper end of the flats the trench was carried down through the soft material to rock, which lies 15 to 20 ft. below the surface, the trench width on the bottom being about 40 ft. Three very heavy rubble-masonry walls, parallel with the line of the sewer, were then built up about to subgrade, one under each outer edge and one under the center line of the twin-sewer section. The space between these walls was filled with broken stone and an extra heavy concrete cradle built over this whole substructure. The heavy masonry footing was continued south until the depth at which the rock lay became excessive, then the standard pile and timber grillage footing was substituted for it.

considerably and had to be re-driven. Then in order to insure their stability their heads were imbedded in a 6-ft. layer of concrete as soon as possible after the re-driving.

The last 1,800 ft. of the outfall parallels the tracks of the New York Central & Hudson River R. R. so closely that derricks could not be used on that side, while on the opposite side much of the ground is little above high tide. The excavated material was mostly dumped on the water side of the trench from buckets handled by derricks placed on the line of the sewer. The piling was driven by a land driver. Materials for construction were delivered in cars on a narrow-gauge track laid on a trestle built just outside the railroad right of way. Much of this part of the trench was very wet and had to be pumped continually.

A large masonry outlet chamber, which has its



Transverse Cross-Section of Outlet Chamber on One Side of Division Wall; Front Elevation of Outlet Chamber.



Two Views of the Same Portion of the Work Showing Typical Methods of Construction on the Lower End of the Outfall.

In the construction work on the twin sewer from its north end to the railroad crossing the excavated material in bad ground was handled in buckets by guyed or stiff-leg derricks set up on one side of the trench. In good ground this material was removed in two-wheeled, one-horse carts and hauled back to make the fill over the completed work. The concrete was all mixed by hand on platforms set at subgrade in the trench. Although considerable of this part of the trench could be made without sheeting, a number of pulsometer and centrifugal pumps had to be used in most of it to keep the ground water down.

The rock ledge continues south from the railroad crossing for a few hundred feet to the edge

The sewer is largely outside the high-water line from the beginning of the pile foundation work to within a few hundred feet of the outlet, and is built through a bog formation overlying rock or glacial drift to varying depths. Piles, 25 to 60 ft. long, were driven into the mud and cut off at sub-grade. The material around their heads was then removed to a depth of 2 ft. and a solid floor containing a layer of 2-in. and one of 4-in. plank laid over the bottom of the excavation. Concrete was placed directly on this floor and carried up to the sewer inverts. After the material had been removed around the heads of the piles it was difficult to keep them in position until the concrete could be placed. Some of them rose

discharge openings submerged 1 ft. at mean low tide and 7 ft. at mean high tide, has been built at the end of the outfall. This chamber is a trapezoid in plan, 57 ft. long on its outer side along the river, 41 ft. long on its inner side where the outfall joins it, and uniformly 21.5 ft. wide. It has a total height of 22 ft. and is built of ashlar granite masonry, with a heavy flat concrete roof carried on I-beams. The interior of the chamber is divided in two equal parts by a transverse wall built as a continuation of the common center wall of the twin-sewer section. The inverts of that section are at mean low tide level where they join the outlet chamber. The floor of the latter is made up of granite steps, begin-

ning at the end of the outfall inverts and descending uniformly to a depth of 15 ft. below mean high tide at the opposite side of the chamber where the outlet openings are placed.

Each of the two interior parts of the chamber is 15 ft. wide at the side where the outfall joins it and is broadened to 19 ft. at the river side by the divergence of the end walls of the whole structure. The two parts are cross-connected by two 5 x 7-ft. arched openings in the division wall between them, the bottom of openings being 1 ft. below low water. The discharge outlets from the chamber are four openings, two in each division, on the river side. These openings are each 8 ft. wide and 8 ft. high to the springing lines of the flat arches over them. They will be submerged, except at an extremely low tide, so the chamber will always be water-sealed to low tide level. As the outfall is laid on a grade of approximately 1 to 1,000 the high-water tidal influence will extend 6,000 ft. from the outlet. The discharge openings being always submerged will prevent any floating material from entering the outlet chamber from the river, while the heavy flow through the sewer is expected to prevent an accumulation of sediment in the chamber.

The outlet chamber is built with its outer edge on the government bulkhead line and in about 18 ft. of water overlying the mud which covers a sand and gravel bottom. A bulkhead which the government had built was first removed, then the site was dredged 22 to 23 ft. below mean high tide and 222 piles, 25 to 30 ft. long, driven 21 ft. into the sand and gravel bottom. The piles were cut off 17.5 ft. below high-water level with a marine saw mounted on a rigid platform movable laterally over the site. A row of 2 x 12-in. sheeting was then driven under water, with the assistance of a diver, around the outer rows of piles, the top of the sheeting being left above the top of the

under water. It was mixed by hand on the bank and lowered away through 16 to 25 ft. of water in bottom-dump buckets by two stiff-leg

brought the concrete to an even surface when the heads of the piles were covered to a depth of 6 in.



Pile Footing Being Driven in Thick Stratum of Silt.



Heavy Rubble Masonry Substructure Built up from Rock Foundation.

piles. The heads of the piles were imbedded in a 5-ft. layer of concrete, which was extended beyond the piles on the sides to form an apron and prevent scouring.

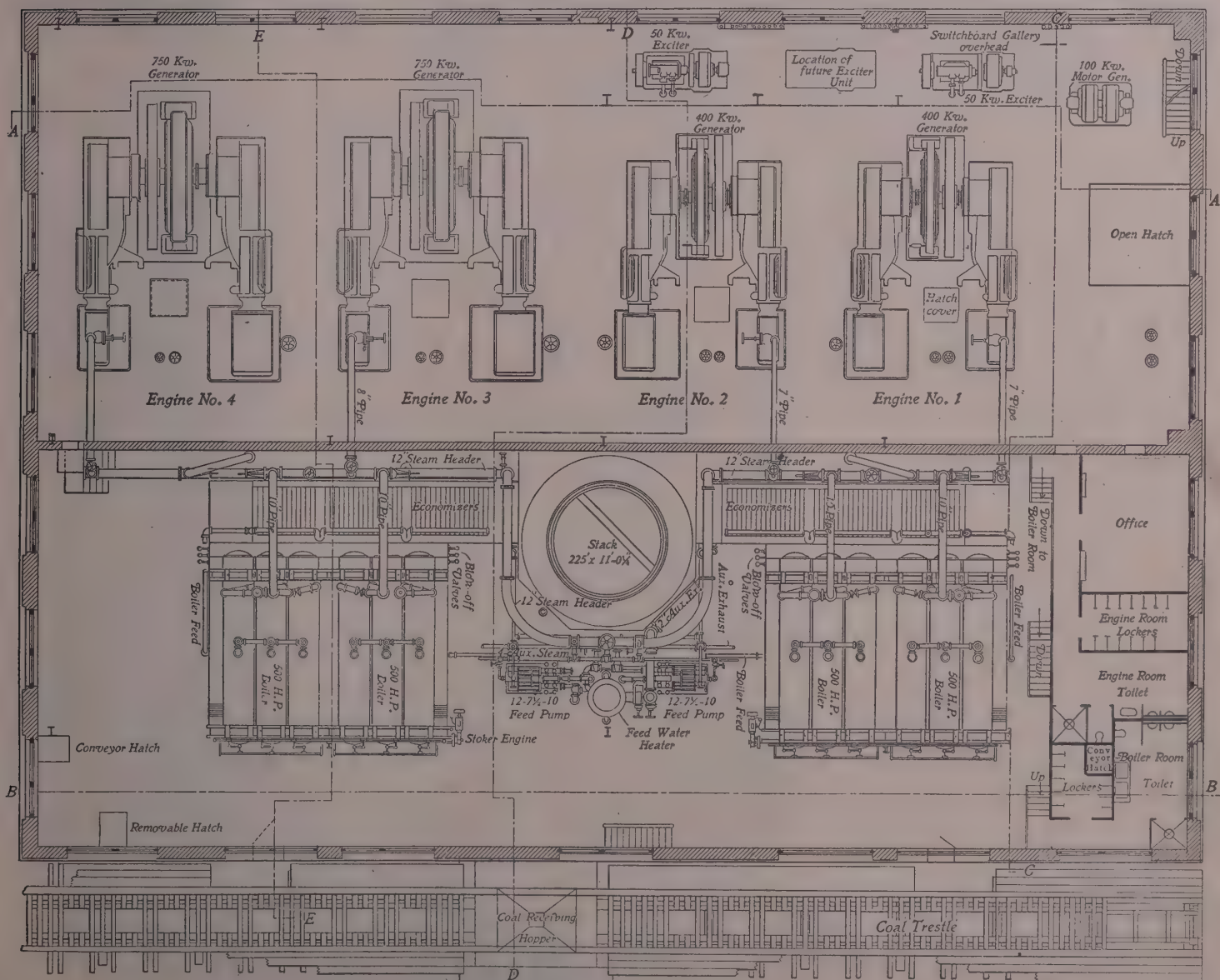
The concrete for the footing was laid loose

derricks on the bank, and the buckets dumped by a diver. In all 214 cu. yd. of concrete were placed in this manner. By carefully lowering and dumping the buckets no difficulty was experienced with the cement washing away and the diver easily

An open flat-bottomed timber caisson, a little larger in plan than the masonry of the chamber was then built up along the bulkhead and floated approximately into place. This caisson had a solid floor of 12 x 12-in. timbers covered by a layer of 2-in. and one of 4-in. plank, all drift-bolted together. The sides were 4-in. sheeting nailed to 8 x 8-in. studding and calked with oakum. They were built so they extended 5 ft. above high tide when the caisson was lowered, and were capped with 12 x 12-in. timbers, mortised together at the corners and drift-bolted to the 8 x 8-in. studs. When the caisson had been anchored roughly in position masonry was laid in 't until at low tide its bottom nearly touched the concrete over the piles. It was then located exactly and scuttled at a falling tide. When it had settled in place it was weighted to hold it on the concrete. It was then pumped out and the masonry laid. A cofferdam was built from each inner corner of the caisson to the land when the walls of the outlet were about finished, then the land side of the caisson was removed. The outfall, which had been built to within about 50 ft. of the outlet chamber and bulkheaded, was then extended to the latter without difficulty.

The outfall sewer was built by the department of sewers, borough of the Bronx, New York City, Hon. Louis F. Haffen, borough president. Mr. H. H. Farnum was chief engineer of the department during the preliminary work on the outfall. Mr. J. H. Fitch, principal assistant engineer, had charge of the department from August, 1900, to January, 1902, when Mr. J. A. Briggs became chief engineer of the borough of the Bronx, and Mr. C. H. Graham, engineer in charge of sewers, which positions these gentlemen still retain. Mr. E. F. Austin, assistant engineer, was in immediate charge of the work practically from its inception. Mr. Bart Dunn, of New York City, was the contractor for the construction of the outfall.

Eng. Record, April 8, 1905, recently completed in which the electrical method of power transmission seemed almost a necessity for entire safety from fire under the conditions encountered in such buildings. As improved lighting facilities for the yard and terminal buildings were also imperatively demanded, it was seen to be only a short step further to combine the source of power for these varied purposes into a large, complete



PLAN AND CROSS-SECTIONS OF THE WEEHAWKEN POWER STATION, WEST SHORE R. R.

and highly economical power station centrally located, from which current could be distributed. The result has been the new plant here referred to, which has recently been completed with a rated capacity of 3,700-h-p.

The power requirements embraced the operation of the old export grain elevator of 1,200,000 bushels capacity, the new 2,000,000-bushel elevator, which is the largest in the New York harbor, the terminal locomotive and car repair shop, the marine equipment repair shop, the transfer bridges by which car floats are loaded and unloaded, and the lighting of the car storage and classification yards, elevators, shops and passenger and freight terminal buildings. These buildings are distributed over a yard 6,700 ft. long and approximately 1,500 ft. wide, lying between the base of the Palisades on the west side of the Hudson River and the river's edge, so that the distances of distribution are considerable. This necessitated either a high-voltage transmission or a central location of the plant, the latter being adopted as available space for the power house was to be had near the center of the yard, so located as not to interfere with the track arrangement. The site is almost op-

with the boiler fronts to assist the roof structure in supporting the coal bunkers above the firing floor, but, being utilized as part of the boiler-setting framework, they do not occupy valuable space.

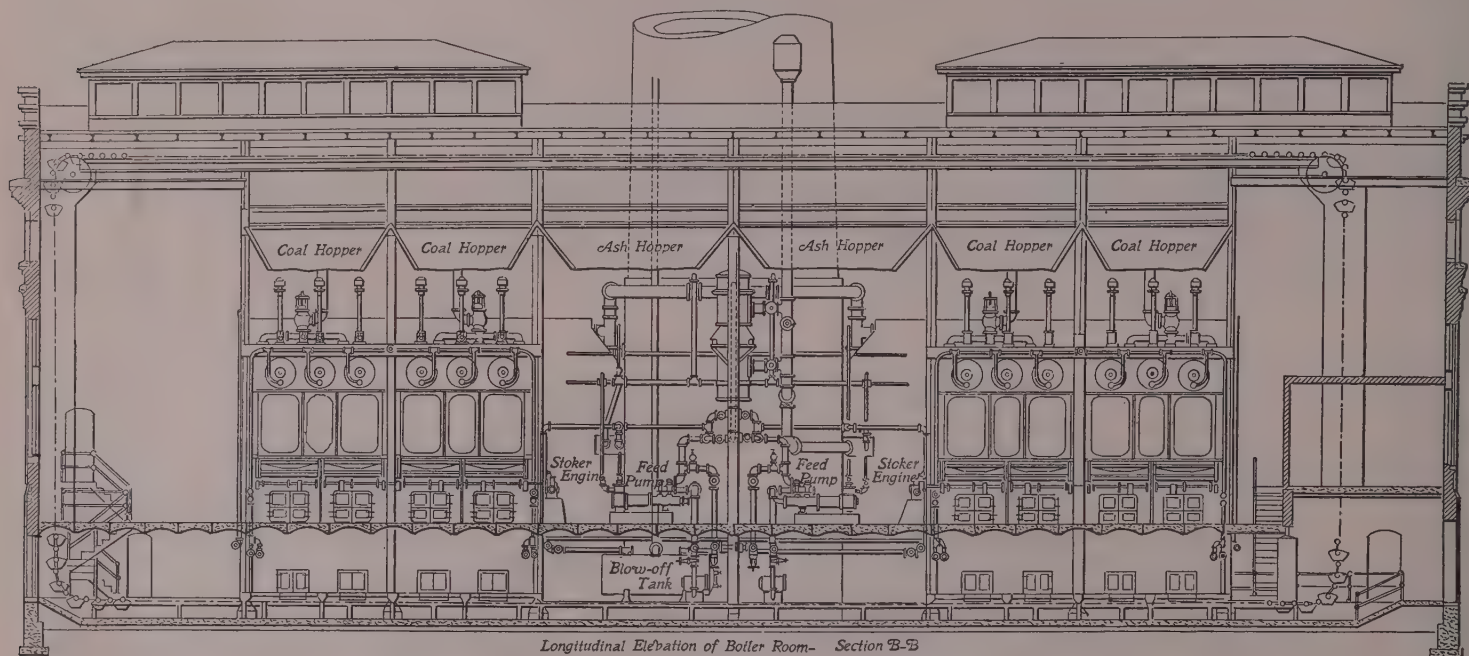
The exterior of the structure has been plainly treated architecturally, yet a pleasing result has been obtained. The allotment of approximately equal spaces to the boiler and engine rooms and the use of similar roof structures over both, did much to render a symmetrical design possible, and yet without sacrifice in any direction. The side walls are of brick with sandstone trimming, on concrete foundations reinforced with scrap rails. The roof is of 3-in. concrete slabs reinforced with No. 16 galvanized iron wire, laid on the T-bar purlins and faced with Portland cement mortar. The water-proofing covering consists of a layer of pitch, spread on hot and covered with slag. The monitors are finished on the sides and ends with No. 16 sheet copper and inside roof drainage is provided to prevent freezing.

The building is well raised for drainage and ventilation, the basement floor elevation being level with the bases of rails in the adjacent yard,

trically-operated traveling crane, supplied by the Alfred Box Co., Philadelphia, Pa. This is carried on 42-in. runway girders 50 ft. apart on centers.

Boilers.—The steam supply for the plant is generated in four horizontal water-tube boilers, each of 500-h-p. rated capacity, which are arranged in two batteries, one on either side of the base of the stack, each setting occupying a space of 15 x 23 ft. Each boiler has 5,000 sq. ft. of heating surface, the horse-power rating having been based on 10 sq. ft. per horse-power, and the working pressure is 150 lb. Each has 252 4-in. tubes, 18 ft. long, arranged in 21 sections of 12 tubes each; these are connected to three 36-in. by 23-ft. steam drums and a 12-in. by 12-ft. mud drum. The boilers were built and installed by the Aultman & Taylor Machinery Co., Mansfield, O.

Each boiler is fitted with a Foster superheater supplied by the Power Specialty Co., New York, having 1,250 sq. ft. of superheating surface and designed to raise the temperature of steam delivered at 150 lb. to 550° Fahr. The superheaters are of the flue-fired type, arranged between the nest of boiler tubes and steam drums, and have



Longitudinal Section of Boiler Room Showing Coal and Ash Handling Apparatus.

posite the elevators, which are the largest points of power consumption, and thus most favorable for the distribution system. The distance to the north end where the marine shop is located is fully half a mile, while that to the passenger depot at the south end is 3,500 ft.

Building.—The power house is a substantial building of steel and brick construction, having overall dimensions of 105 ft. 8 in. by 146 ft. 4 in. It is divided by a partition wall parallel to the river into an engine room, 52 ft. wide, on the front or river side, and a 49-ft. boiler room at the rear. The engine room has a 12-ft. basement and 28-ft. headroom beneath roof trusses, while the boiler room has a clear headroom of 32 ft. and an 8-ft. basement, the floor of the latter being 4 ft. below that of the engine room. The west end of the boiler room is partitioned off to a width of 15 ft. for the accommodation of offices, and locker and toilet rooms for the station attendants. The engine room is free from obstructions, with the exception of a 10-ft. gallery at one corner for the accommodation of the electrical switching apparatus, thus permitting unobstructed movement of the traveling crane. The boiler room has a row of columns in line

so that both basements are located above ground, and thus well lighted. The floors of the basements as well as the main floors are of concrete with neat cement surfacing, and the main floors are reinforced with rods between the steel floor-beams. The foundations for engines, auxiliary units and boilers are concrete, in all cases built as monolithic structures. The heavier foundations are underpinned by piles driven down to solid rock. The stack foundation is extra heavy, having been designed to carry a much greater weight than is now imposed by the present 225-ft. stack; it will permit of an extension of the stack of 50 ft. should more boilers be added or the territory on top of the neighboring Palisades cliffs become residential in character, so that the gases might prove objectionable. An interesting provision in the building is that for access of heavy machinery and parts to the main engine room. At the south end of the room there is a hatchway in the floor 12 ft. square, below which there is an 8½ x 9¾-ft. door in the south basement wall, opening outward to the yard. Through this door heavy parts are skidded into the basement beneath the hatch opening, through which they are lifted directly by a 20-ton, single-trolley, elec-

metal-to-metal joints throughout, with no packing of any kind. Each superheater is built in three sections, each with 24 U-shaped tubes, 4 in. in diameter. They are provided with the necessary by-pass connections for delivery of saturated steam when desired.

The boilers are fitted with Roney overfeed stokers, installed by Westinghouse, Church, Kerr & Co., which are guaranteed to consume the coal smokelessly when it is supplied in proper sizes. Each stoker has an overall-width of 12½ ft. and length of 8 ft. 2 in., the total effective grate area being 112 sq. ft. The stokers are designed to burn at rated capacity, 15 lb. of coal per square foot of grate per hour, and at 50 per cent. overload, 22 lb. The draft required for the operation of the stoker at rated load is ¾-in. of water and at 50 per cent. overload, 1½-in. The stokers of each battery are driven together by a 4 x 4½-in. special Westinghouse stoker engine, each stoker requiring approximately 1 h-p. to operate.

Draft.—Each boiler discharges its gases of combustion into a longitudinal masonry flue on the floor level at the rear of the boilers, which leads across to the stack at the center. This flue on either side of the stack has two outlets, one

direct to the stack and the other, at the outside end, to the economizer which is carried on top of this flue. Suitable close-fitting dampers are provided for throwing the current of the gases in either direction as desired. This main flue, which is 5 x 6 ft. in section, has a rowlock firebrick arch for the top, which is covered with a similar arch of common brick, and above this is a bed of cinder concrete, which forms the floor of the economizer chamber. The economizer flue has sloping ends which are carried on cast-iron tees. An auxiliary flue below the boiler-room floor leads from the stack across to the north end of the building, which is intended to provide for the addition of two boilers at that end if at any future time such an increase should become necessary.

The two economizers, which were installed by the Green Fuel Economizer Co., Matteawan, N. Y., have total heating surfaces of 4,576 sq. ft. each. Each has 44 sections of 8 tubes to a section, the tubes being of cast iron, $3\frac{3}{8}$ in. by 10 ft. in size, connected into the headers at top and bottom. The feed water enters at the cooler end of the economizer chamber and leaves from the end nearest the boiler. The usual scrapers are employed for keeping the tubes free from soot, and are driven by a 2-h-p. motor.

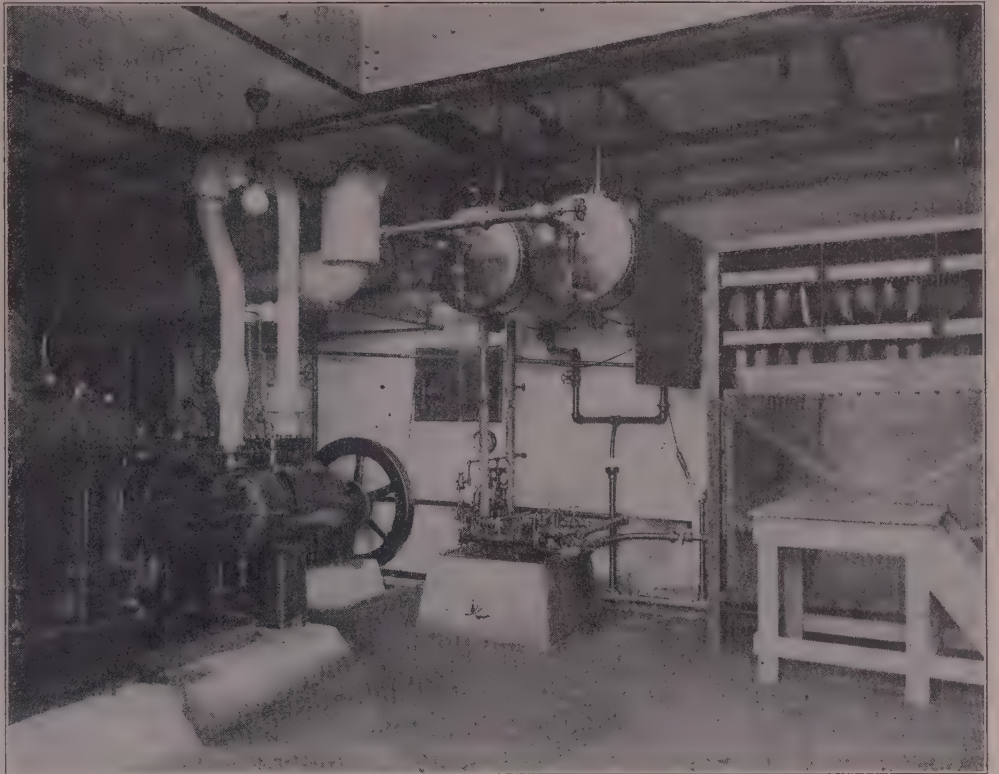
The stack is of the radial brick type, 225 ft. high, with an internal diameter of 10 ft., and was built by the Alphons Custodis Chimney Construction Co., New York. It is of ample size to handle normal and 50 per cent. overloads on the present boiler equipment, and in addition the two future boilers for which space has been reserved at the north end of the boiler room. It is proportioned for an increase of 50 ft. in height in case this becomes necessary, which will give an eventual height of 275 ft.

Coal and Ash Handling.—All of the handling of coal and ashes is mechanical, storage hoppers

which is capable of reducing "run of mine" coal, either anthracite or bituminous, to stoker sizes at the rate of 30 tons per hour.

The conveyor system includes a belt cross conveyor which delivers from the crusher across the basement to a point under the boiler fronts, and a bucket conveyor passing under the room longi-

tudinally. Automatic trips on the upper run over the hoppers permit these to be dumped at any point desired. This conveyor is driven by a 30-h-p. reversible variable-speed, three-phase alternating-current motor, while the cross-belt conveyor and the crusher are driven through a countershaft by a similar 20-h-p. non-reversible



Circulating Pumps and Oil Filtering Equipment in the Basement



General View in Engine Room, Weehawken Power Plant.

having been provided above the firing floor to which delivery is made by bucket conveyor. Coal is delivered to the plant on a trestle at the rear of the boiler room, from which it is dumped directly into the receiving hopper beneath, in an extension of the boiler room basement. The coal passes thence into the system through a crusher

tudinally and raising the coal to the storage hoppers above. The belt conveyor has an 18-in. belt which carries the coal a distance of 18 ft. from the crusher spout to the bucket conveyor, and is designed for a speed of 400 ft. per minute. The main bucket conveyor is of the link type with pressed steel 18 x 26-in. buckets spaced 28 in.

motor. The capacity of the combined system, which was installed complete by the Exeter Machine Works, Pittston, Pa., is 30 tons of coal per hour.

There are four elevated coal-storage hoppers and two ash hoppers carried above the firing floor, each of the former having a capacity of 35 tons, or 140 tons in all, while the two ash pockets are calculated to take care of the maximum accumulation for three days. Each hopper is $13\frac{1}{2}$ x 15 ft. at the top, with the chute openings 19 ft. above the boiler room floor. The chutes discharge directly into the stoker hoppers, while the ash pockets slant toward the outer wall to chutes which lead outward for delivery to cars on the trestle alongside. The ashes are handled by the longitudinal bucket conveyor, which passes in front of the furnace ash-pit outlets in the basement, so that they may be raked directly into the conveyor while it is in operation.

Feed-Water System.—Both the feed-water supply and the blow-off system have been carefully designed for entire reliability of service. The feed system has been laid out in duplicate throughout, from the two separate sources of water supply through the two feed pumps, etc., and to the boiler connections. Water is obtained through a 6-in. connection to both the high-pressure and low-pressure city water systems, each of which leads through Worthington water meters to the suction of both feed pumps. The pumps deliver through the feed-water heater first and then the economizers to the boilers. The connections to these are in all cases duplicated and by-passed, the 4-in. delivery mains to the boilers being in duplicate beneath the floor, from which the individual branches are brought up to the boilers. These branches to the boilers are of heavy brass pipe with flanged connections, the remainder of the piping being of "special full

weight" galvanized steel. Excessive pressure is prevented by relief valves in the pump delivery.

Two boiler feed pumps are provided, each of which is capable of feeding the entire boiler equipment. The pumps are Worthington outside-packed plunger pressure pumps, with "pot" valves fitted to handle cold water. Each has 12 and 7½-in. cylinders with a common stroke of 10 in., and a capacity of 22,000 gal. water per hour delivered, against a pressure of 300 lb. at a piston speed of not over 100 ft. a minute. The pumps are located on the boiler-room floor adjacent to the base on the stack, the feed-water heater being located directly above on a special steel platform. This heater is a vertical Wainwright closed-tube type heater and is capable of raising the temperature of 70,000 lb. of feed water per hour from 40° to 100° Fahr., with 7,000 lb. of exhaust steam at atmospheric pressure.

The blow-off piping system includes three blow-off connections from each boiler, a blow-off from each economizer and one from the feed-water heater. These all empty into a special blow-off tank through a 4-in. blow-off main and a 6-in. overflow leads from this tank to the sewer. The blow-off connections from each boiler consist of three 2½-in. asbestos-packed blow-off cocks at the mud drum, these cocks being connected to the blow-off main through a 2½-in. Cadman angle blow-off valve. The blow-off piping is flange-connected and tees and crosses are used in place of elbow fittings wherever possible, blank flanges being applied to the vacant sides, thus permitting ready access for cleaning out pipes. The blow-off tank is located beneath the feed pumps and consists of a horizontal cylindrical tank 4 ft. in diameter and 11 ft. long, designed to withstand a pressure of 200 lb. per square inch. A 6-in. pipe leads from the top of the tank to the roof, to serve as a vapor discharge to atmosphere.

Steam Piping.—The steam piping system is laid out on the longitudinal header system with long-radius bends to the boilers and similar branches through the partition wall to the engine units. The boiler branches are of 10-in. pipe and the header 12 in., while the engine branches are 7 and 8-in. pipe. The header is carried on a pipe gallery in the rear of the economizer setting at a height of 19½ ft. above the boiler room floor. Where the gallery is interrupted by the base of the stack, the header is carried around in a loop with double-elbow vertical off-set connections at each end. The header is arranged in sections, so as to permit of individual connections between adjacent boilers and engines. There are four of the sections connected by stop valves, and each of the sections connects with one boiler and one engine, resulting in a flexible and convenient arrangement, since the equipment can be cut into four practically separate and individual power plants. The header is fastened rigidly at the middle point of each portion of the gallery and allowed to expand in either direction, for which provision is made at intermediate points of support. Ten-inch stop valves are provided in each boiler connection, one at the superheater outlet and another close to the header. Two valves are provided in each engine connection, one the engine throttle and the other an angle valve just above the header.

An auxiliary system of steam piping is provided to supply the pumps, stoker engines, exciter engines and condenser pumps, which consists of a header extending through the engine room basement at the rear of the large exhaust header. It is made up of two sections of 8-in. pipe, each fed from the main steam header above through an 8-in. feeder; both sections are joined together at the middle by a long radius bend of 6-in. pipe to provide for expansion. A 4-in. branch supplies the pumps in the boiler room,

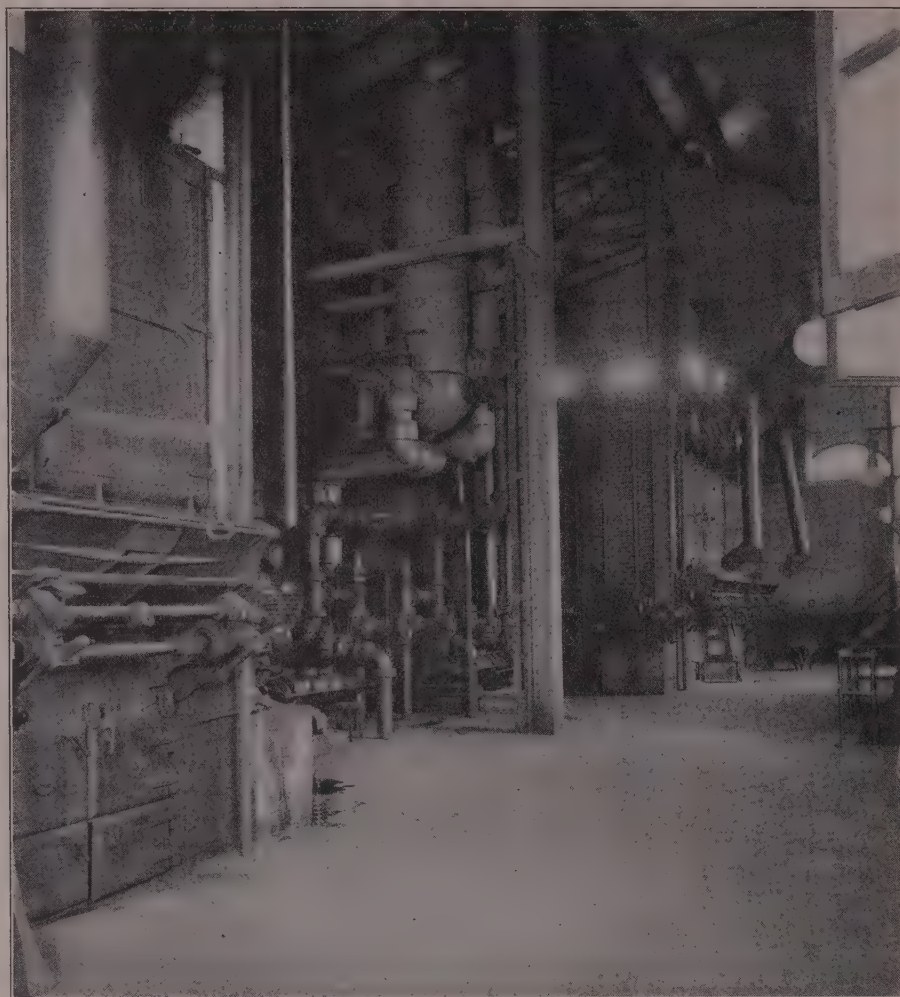
and a 6-in. loop extends across the engine room basement to supply the exciter engines and condenser pumps. Auxiliary connections are also provided from this header to the low-pressure cylinders of the large engines for starting purposes. The auxiliary header is divided into two sections by a stop valve so as to prevent a complete shut-down in case of accident.

Engines.—The main engine equipment consists of two 1,200-h-p. and two 650-h-p. compound condensing Corliss engines direct-connected to three-phase, alternating-current generators. They are of the heavy-duty compound type, with receiver, and the generators located between the cranks. The engines are of the improved horizontal Corliss design recently brought out by the Westinghouse Machine Co. They are designed with particular reference to parallel operation, having similar characteristics of speed regulation. The engine guarantee provides that when the load is

steam pressure at the throttle of 140 lb. and a 25-in. vacuum. They have 18-ft. flywheels weighing 30 tons, and occupy a total floor area of 33½ x 27 ft. The 650-h-p. engines have 20 and 40 x 42-in. cylinders and operate at 120 r.p.m. They are equipped with 15-ft. flywheels weighing 20 tons and occupy floor areas of 29 x 21 ft. each. All of the engines are equipped with metallic packing and have relief valves of ample size to protect the cylinders from water of condensation.

The engines operating the exciters are 90-h-p. vertical cross-compound machines of the standard single-acting type of the Westinghouse Machine Co. Each has 10 and 18 x 10-in. cylinders and with same operating conditions as for the main engines, runs at 320 r.p.m. These engines have the Westinghouse centrifugal type of shaft governor and are designed to regulate within 2½ per cent. from no load to full load.

Lubrication for all the machinery is accom-



The Auxiliary Equipment in the Boiler Room.

suddenly thrown on from no load to full load the engine shall not vary in speed sufficiently to permit the generator to run ahead or fall behind a machine running at absolutely constant speed of the same number of revolutions per minute, by more than .15 of one degree. The governors are of the safety fly-ball type and control the cut-off in both the high and low-pressure cylinders. The speed control is such that speed variation does not exceed 2 per cent. for a 5-lb. change in steam pressure above or below normal, and 3 per cent. when full-rated load is instantly thrown on or off. In addition to the safety feature of the governor, the engines are fitted with Monarch safety stops, arranged to automatically cut off the steam supply in case the engine speed increases more than five revolutions above normal.

The 1,200-h-p. engines have 25 and 48 x 48-in. cylinders and operate at 94 r.p.m. with a normal

plished by a gravity system, which provides a complete automatic closed oiling system on each engine, in addition to triple sight-feed lubricators and hand-cylinder oil pumps on each cylinder. Drip pans and return pipes collect and lead the used oil back through an oil filter and purifier to a 150-gal. supply tank. A complete piping system leads from this tank to the various sight-feed oil reservoirs and to all other parts of machinery requiring lubrication.

Condensers.—There are two exhaust steam systems, one for the main engines which are operated condensing and the other for the auxiliary engines and pumps, the exhaust from which is being led to the feed-water heater and thence discharged to the atmosphere. The main exhaust line extends longitudinally through the basement beneath the engine cylinders to the condenser connection at the south wall and is in two sec-

tions, one of 20-in. and the other of 30-in. pipe. It ends in a 30-in. riser outside the south wall of the building, which leads up to the barometric condenser near the roof and to a 24-in. atmospheric relief valve above. The condensers, which are of the central jet type, are located one on either side of the riser, and have 20-in. inlet connections and 10-in. cold-water injection connections. A dry-air connection is provided, and a 10-in. tail pipe extends from the condenser chamber to the hot well. Circulating water is furnished by two steam pumps, which take their suction through special strainers and foot valves from an intake well receiving water from the Hudson River. The suction connections are of 12-in. and the delivery of 10-in. pipe. A dry vacuum pump is provided for removing the accumulated air from beneath the condensing cones. The capacity of the condensing outfit is sufficient to take care of 55,000 lb. of exhaust steam per hour and maintain vacuum.

Electrical Equipment.—The electrical equipment of the plant comprises two 750-kw., 600-volt, three-phase, 25-cycle alternators, built by the Bullock Electric & Mfg. Co., which are direct-connected to the 1,200-h-p. engines; and two 400-kw., 2,300-volt, three-phase, 60-cycle alternators, built by the General Electric Co., which are direct-connected to the 650-h-p. engines. There are in addition two 50-kw., 250-volt, direct-current exciter units and a 100-kw. motor-generator, with one side arranged for the 2,300-volt, 60-cycle current and the other for the 600-volt, 25-cycle system; the purpose of this unit is to permit either system to assist the other, and it will be particularly useful when the load on one system is very light, by permitting the entire load on that side to be carried from the other. The main alternators are all of the revolving-field type and are wound for close regulation and heavy overloads.

The selection of both 25 and 60-cycle generating apparatus is of much interest. The 25-cycle current is far better adapted to the operation of motors, while, on the other hand, it is not so successful for lighting purposes, particularly for use with arc lamps. For the operation of the motors it was found that if 60 cycles were used, the correspondingly higher motor speeds encountered would necessitate much more involved gearing or speed-reduction systems, and from this source alone the use of the 25-cycle system instead of the 60-cycle effected a saving of upwards of \$10,000. On the other hand, satisfactory operation of the lighting equipment made the use of a distinct system for the generation of the 60-cycle current supply practically a necessity, the use of frequency changers not offering sufficient advantages to warrant their use. The low voltage for the power system was possible because the bulk of the power was to be used in the export grain elevators nearby, while for the lighting service over extended areas, 2,300 volts with step-down transformers promised more economical results.

The switchboard equipment is located in the gallery in the southeast corner of the engine room 11 ft. 4 in. above the floor level. It has 32 standard General Electric panels, which are distributed as follows from right to left: Three exciter panels, five blank panels, eight feeder panels, four lighting feeder panels, a totalizing panel of the 60-cycle system, seven machine panels, a totalizing panel for the 25-cycle system and three power feeder panels.

The electrical circuits supplying power and light to the grain elevators directly across the yard are run in a conduit line beneath the tracks to a manhole near the old elevator, from which branches are carried into each elevator. The other feeders for both lighting and power are carried in lead-covered cables from the switchboard down through the basement and up through

a special cable tower to the lightning arrester racks, from which the overhead distribution lines begin. The motor equipment of the new elevator consists of 45 three-phase induction motors, which, being without exposed or sliding contacts, are best adapted to this class of service. Of these, 23 motors of 100-h-p. each are used for the operation of receiving, shipping, transfer and cleaning elevators; two, of 60-h-p. each, run a dust-collector fan and the belt conveyor on the cupola, while 17, each of 40-h-p., operate the cleaning machines, the car puller, the marine tower, screenings elevator, cross conveyors and dust-collector fans; a 10-h-p. motor runs the passenger elevator, and a 10-h-p. and 5-h-p. motor run two drainage pumps. There is thus over 3,100-h-p. capacity in motors, all of which are operated at 550 volts on the 25-cycle three-phase system.

The power plant as well as the entire electrical installation for the Weehawken terminal was developed under the general direction of Mr. W. J. Wilgus, vice-president, and Mr. H. Fernstrom, lately chief engineer of the New York Central & Hudson River R. R. Co. The architectural features of the building were designed by Mr. C. W. Smith, and the steel structure by Mr. G. A. Berry, both reporting to Mr. Olaf Hoff, engineer of structures. The mechanical and electrical features of the installation were designed by Mr. Edwin B. Katte, electrical engineer of the company.

Book Notes.

The second edition of Mr. C. M. Robinson's "Modern Civic Art" has recently appeared and deserves a warm welcome from those who believe that it is time to pay more attention to æsthetic conditions in our cities. In all such matters relating to art there must always be differences of opinion concerning the actual artistic merit of various structures, squares, fountains and other important features of municipal countenances. There is no such question, however, concerning the relative meanness and offensiveness that marks many cities unnecessarily. This unfortunate condition has been the result of both rapid growth and a lack of knowledge of how to make a city attractive. Fortunately the importance of looking ahead is now recognized, and such books as this by Mr. Robinson are educating the public in the principles of municipal art. These are not difficult to understand, as a perusal of the book will prove, and a knowledge of them is so essential to city engineers and municipal committees having charge of streets and buildings that Mr. Robinson has rendered a public service in preparing this work. The fact that a second edition has been called for so soon is encouraging to those who believe, with this journal, that our civic unsightliness has been the result of ignorance of what to do rather than any lack of desire for artistic surroundings. (New York, G. P. Putnam's Sons, \$3.)

A few weeks ago there was printed in this journal an account of the interesting study of the underground waters in the wasted plain of Southern California, which Mr. W. C. Mendenhall has recently been making for the U. S. Geological Survey. A full report of this investigation has lately been published by the Survey as Water Supply and Irrigation Paper 137. The larger part of this report consists of maps and tables. The text is brief and chiefly descriptive, but includes a discussion of the effects of development and drought in bringing about those changes in water levels and in the outlines of artesian areas which have been most marked within the last five or six years. The maps presented with the report show the areas irrigated in the spring of 1904, when the field work was done, the pumping plants and dis-

tributing systems by which the water is procured and conducted to the land where it is used, the areas of artesian water-bearing land at the beginning of 1904 and the original artesian area, the zones of relative alkalinity in the underground waters, and the elevation of the planes of saturation outside of the present artesian belt. Where the data are sufficient the elevation of the plane of saturation is shown by means of contours.

A book which outlines many new methods in teaching elementary physics has been prepared by Prof. C. R. Mann, of the University of Chicago, and Prof. Geo. R. Twiss, of the Central High School, of Cleveland. In this "Physics" the authors depart from many of the firmly accepted precedents of instruction in elementary physics. The "attempt to force mathematics on a boy's brain processes" is abandoned, the problems relate as far as possible to concrete cases, and an attempt is made to encourage the habit of accurate observation by illustrating the principles in the text by familiar objects and phenomena. Historical notes are plentiful and the processes by deduction and experiment by which important physical laws were discovered are occasionally explained. The authors have deliberately tried to give the student the impression that science leads to no absolute results, that at best it is merely a question of close approximation, and they have also refused to cumber the book with descriptions of experiments which should either be performed by the instructor in the class room or by the pupils in the laboratory. Taking the book as a whole it is an interesting attempt to teach physics as a science of immediate practical applicability. (Chicago, Scott, Foresman & Co., \$1.25.)

A book of interest to many who will be able to derive no personal profit from its reading is "Practical Planer Talks," by Carroll Ashley. The short pithy suggestions which mechanics sometimes prepare to help along the young fellows just beginning their work deserve hearty praise. It is true that once in a while some of these articles wander all around their subjects, but most of them are right to the point. A mechanic is not usually so fond of the pen that he writes easily, and a book like this was manifestly produced with some effort, which has resulted in making it concise and good. It is a good many years since the writer of this review was himself a planer hand and in the intervening years these tools have been greatly improved; nevertheless, the suggestions about the care and adjustment of planers, the selection and use of tools and the methods of using the planer for various purposes would have been decidedly useful long ago and can be strongly recommended now. This recommendation is the more gladly made because the whole spirit of the book is wholesome and practical, from the introductory suggestion that a planer hand has plenty of time to think about ways of improving his work to the closing suggestion, "Don't think the shop will shut down if you quit." (New York, Hill Publishing Co., cloth, \$1.00.)

For some time the United States Geological Survey has been making examinations in the field of the leading characteristics of water supplies. For this purpose the Survey has developed, with the help of numerous specialists, a system of approximate tests which is explained in a monograph on "The Field Assay of Water," written by Mr. Marshall C. Leighton. In this field work the accurate methods of the permanently located laboratory are, of course, impracticable, but the author contends that for many purposes the approximate results are as useful as those of

greater accuracy. In his opinion, an occasional isolated sanitary analysis of water is without value, and the inorganic constituents of a water should invariably be expressed as positive and negative tons, as errors arise altogether too frequently from the conventional methods of expressing results. The author states that many analyses of water are made for other purposes than the determination of the potability of a given supply, and he contends that the methods outlined in this pamphlet are often all that are required. Moreover, they have the great merit of enabling a rapid survey to be made of the waters of a district and of furnishing a means for detecting readily any marked change in the character of any water. The determinations described in the monograph are for turbidity, color, total hardness, alkalinity, normal carbonates, bicarbonates, total sulphates, total chlorides, iron and calcium. The pamphlet is published in the series of water supply and irrigation papers of the Survey, and can be obtained on application to the Director at Washington.

NEURE WÄRMKRAFTMASCHINEN. By Prof. E. Josse. Munich, R. Oldenbourg; paper, 4to, 7 marks.

A year or more ago Prof. Josse delivered an address before the Society of German Engineers on the present development of steam and gas engines, in which he outlined the results of his tests of important power installations as well as research work in the mechanical laboratory of the Berlin Technical Institute. This address has been greatly developed in a well-illustrated book bearing the above title. The first chapter covers the general subject of steam and gas engine efficiency, the second describes tests with a three-cylinder engine with a surface condenser giving different vacuum conditions, the third reviews tests with steam turbines and pays special attention to variations in the vacuum, the fourth describes a series of tests of a small portable engine and boiler with double superheating, and the fifth reports tests with mechanical stokers and an elephant type boiler.

These tests and the criticisms of them are very instructive, as Professor Josse has an exceptional opportunity for acquiring comprehensive information regarding the operation of steam and gas engines, both in the laboratory and in commercial installations. Many of his statements concerning large gas engines and steam turbines, being based on a knowledge of working results, are not so enthusiastic as those of salesmen who start out to do or die. While much of the information in the book has been obtained by Prof. Josse or his assistants, he has not hesitated to draw on the results of reliable tests by others, and the work is consequently a really comprehensive though concise statement of the present status of steam and gas prime-movers.

INDIAN STORAGE RESERVOIRS WITH EARTHEN DAMS. By W. L. Strange, Under-Secretary to the Public Works Department of India. New York, Spon & Chamberlain; cloth, \$7.50.

This valuable work is particularly interesting to American readers because it explains the conditions governing the design of many Indian irrigation works, which seem unusual, unless this information is at hand. The author points out the great variations in rainfall and the even greater variations in run-off between wet and dry years in India. For example, the run-off of the catchment basin supplying the Ashti reservoir was but 1.9 per cent. of the total rainfall in 1884-85, while the next year it was 24.5 per cent. It is this fluctuation in the percentage of run-off that makes water storage in the Indian plains so difficult, although the heavy losses from evaporation and seepage, sometimes exceeding 1-3 in.

per day in Bombay, add to the troubles of the irrigation superintendent and render it commercially unadvisable to attempt to store water for two years.

The earth dam is the favorite structure for these Indian reservoirs, owing to its low cost in comparison with masonry. It is interesting to observe, however, that neither the puddle wall used in British earth dams nor the masonry core in favor in the United States is considered necessary in India. This omission of any kind of core makes it necessary to construct the whole embankment of impervious material which will be stable when saturated, and one of the novel portions of the book to American readers is given up to directions for the proper mixing of earths to secure these qualities. The details of actual construction of these structures are taken up very fully, and the suggestions for preparing foundations are unusually full. There is also an interesting section relating to slips and their repair. The description of the method of carrying discharge culverts through a dam is instructive as indicating indirectly that the uniform settlement of a homogeneous dam does not crack these culverts in the way that sometimes happens in the case of culverts built through the base of a dam with a core wall.

Letters to the Editor.

PUBLIC WORKS IN PHILADELPHIA.

SIR: Our attention has been called to the publication of parts of the report of Messrs. Gillette and McLennan in your paper of this date. In view of the fact, as we are firmly convinced, that this report was published at this time and largely gotten up for the purpose of affecting the present political contest and also the approaching trial of Mr. John W. Hill, lately chief engineer of the Bureau of Filtration of the city of Philadelphia, we ask you to make public, through your journal, this letter, in order that yourselves and the profession may know Mr. Hill's position, and the true reason why he has not had, up to this date, an early trial of his case.

Under our advice Mr. Hill has refrained from making any statements or published answers to the manifold things which have been said and published concerning him and his work, deeming it for his best interests that his case should be made known and his answer presented in the forum established by law for the trial of the questions involved in the accusations against him. We have persistently, under his strenuous requests, made application for an early trial of his case. The arrest was made in June, and this was followed by the summer vacation of the courts, during which this case could not have been tried, and, therefore, early in September, application was made for a day to be fixed. We were told that the case would be set for the 18th of September. On the 18th of September last past we fondly hoped the case would be reached and tried, but, for reasons which were satisfactory to the District Attorney, it was postponed. We made application on the 2d of October to have the Court fix a day, but because it was so near the close of the term the Court declined to do so, remitting the question to his successor in the following month. Meanwhile the District Attorney gave us notice that the 17th of October had been set as the day for the trial. We made all preparation, gathering witnesses from a great distance and going to great expense, so as to be ready to try the case and dispose of it on that day. Again we were met by a postponement. On the application of the District Attorney and against our protest, the Court refused to force the District Attorney to begin the trial, and among other things said that the case should not be tried prior to the election in November. There was no

help for Mr. Hill or his counsel but to submit to the ruling of the Court. It was a matter from which no appeal could be taken, and so, protesting against the delay, we have sat quietly waiting for a new appointment for trial.

Meanwhile this report of Messrs. Gillette and McLennan is published with various comments, and a copy of it is sent to your paper for publication. In our judgment a casual examination of the report itself, by an engineer, will furnish the basis for the refutation of all that it states by way of accusation. We have advised Mr. Hill to make no answer to this report, however hard it may be for him to quietly submit to it, and we are of the opinion, most pronouncedly, that our place for answering is in a court of justice, where we will get fair play. With unabated and absolute and abiding confidence in the entire innocence of Mr. Hill we earnestly urge you, through your influential journal, to ask the brethren of his profession to suspend judgment until his case is tried and the truth disclosed, when there will be no difficulty in their joining with us in the recognition of his innocence. Yours truly,

GEO. S. GRAHAM,
EDW. W. MAGILL,
JOSEPH P. McCULLEN.

Philadelphia, Nov. 2.

AIR SPACE IN GRATES.

SIR: In an editorial in your issue of Oct. 28, 1905, you say that it would be very interesting to compare the views of different engineers concerning the proportion of air space a grate should have to get the most economical results. In my opinion the proportion of air space in a grate has in general nothing to do with the economy, for any effect that this proportion would have on economy is very slight compared with the effect of other conditions, which are continually varying.

A grate should be designed first for strength and durability; second, the space in the grate should be small enough not to let the coal fall through, and should be large enough to let the greatest quantity of air through that ever is needed. As far as economy is concerned, the only effect that the variation in the air space in the grates can have is to allow a greater or less quantity of air go into the furnace, and this quantity of air depends not only on the proportion of air space, but on a great many other things, such as the quality of coal, hard or soft, coking or non-coking, clinkering or non-clinkering, size of coal, depth of coal bed, depth and kind of ashes or clinker on grates, draft in chimney, damper opening, size and kind of gas passages through the boiler, and ash-pit door opening.

It is very essential for maximum economy that the air supply should be such in relation to the rapidity of burning the coal that the resulting gases of combustion should contain about from 5 to 8 per cent. of free oxygen and 14 or more per cent. of CO₂. The conditions which control the constitution of the gases of combustion include all the variables above mentioned as well as the proportion of air space through the grates. There is no probability, therefore, that any series of experiments would show that any one proportion of air space would be better than another, within the limits of, say, 25 per cent. and 75 per cent. In fact, good results have been obtained with as low as 15 per cent. air space. (See my book on "Steam Boiler Economy," p. 152.) The prevailing standard of 50 per cent. is probably as good a proportion as any that can be named, for grates with a smaller proportion are more apt to be choked by clinker. If the proportion is much greater than 50 per cent., the grate is apt to be lacking in strength and durability. Yours truly,

Syracuse, Oct. 31.

WM. KENT.

CURRENT NEWS SUPPLEMENT

NOVEMBER 11, 1905.

DIRECTORY OF NATIONAL TECHNICAL AND TRADE SOCIETIES.

AMERICAN SOCIETY OF CIVIL ENGINEERS. Secretary, Chas. Warren Hunt, 220 West 57th St., New York. Next meeting, Nov. 15, paper on Duluth Ship Canal Bridge.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Secretary, F. R. Hutton, 12 West 31st St., New York.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Secretary, Ralph W. Pope, 95 Liberty St., New York.

NATIONAL FIRE PROTECTION ASSOCIATION. Secretary, W. H. Merrill, Jr., Chicago.

AMERICAN INSTITUTE OF MINING ENGINEERS. Secretary, R. W. Raymond, 99 John St., New York.

AMERICAN INSTITUTE OF ARCHITECTS. Secretary, Glenn Brown, Washington, D. C.

ASSOCIATION OF ENGINEERING SOCIETIES. Secretary, Frederick Brooks, 31 Milk Street, Boston, Mass.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS. Secretary, W. M. Mackay, 235 Water St., New York.

CANADIAN SOCIETY OF CIVIL ENGINEERS. Secretary, Clement H. McLeod, 877 Dorchester St., Montreal.

AMERICAN PUBLIC HEALTH ASSOCIATION. Secretary, Dr. C. O. Probst, Columbus, O.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Prof. M. S. Ketchum, University of Colorado, Boulder, Colo.

AMERICAN SOCIETY FOR TESTING MATERIALS. Secretary, Prof. Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS. Secretary, George W. Tillson, Room 12, Municipal Building, Brooklyn, N. Y.

ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS. Secretary, S. F. Paterson, Concord, N. H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION. Secretary, L. C. Fritch, 1562 Monadnock Block, Chicago.

AMERICAN WATER-WORKS ASSOCIATION. Secretary, J. M. Diven, Charleston, S. C.

AMERICAN FOUNDRYMEN'S ASSOCIATION. Secretary, Richard Moldenke, P. O. Box 432, New York.

ENGINE BUILDERS' ASSOCIATION OF THE UNITED STATES. Secretary, J. L. Lyle, 39 Cortlandt St., New York.

AMERICAN PUBLIC WORKS ASSOCIATION. Secretary, W. H. Flint, Chattanooga.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS. President, J. B. Lober, 1232 Land Title Building, Philadelphia.

AMERICAN SOCIETY OF REFRIGERATING ENGINEERS. Sec. Annual meeting, Dec. 4-5; 12 West 31st St., New York.

NATIONAL ASSOCIATION OF MANUFACTURERS OF SAND-LIME PRODUCTS. Secretary, H. A. Duerr, Wilmington, Del. Next meeting, Dec. 5-7, Detroit.

NATIONAL ASSOCIATION OF CEMENT USERS. President, Richard L. Humphrey, Harrison Building, Philadelphia, Pa.

SUCCESSFUL STARTING OF SINGLE PHASE RAILWAY SYSTEM DRIVEN BY GAS ENGINES.

The Westinghouse interests announce the successful starting of the Warren & Jamestown alternating-current railway system operating between Warren, Pa., and Jamestown, N. Y. The electrical equipment has had several weeks' preliminary run from a small gas engine driven unit temporarily installed in the power house at Stoneham. On Oct. 19, the large gas engines were placed in service for the first time and a permanent operating schedule was inaugurated.

Probably the most interesting feature of this rather unique railway system is the exclusive employment of horizontal double-acting gas engines of the heavy duty type for the generation of power to operate the road. Two of these engines are now installed, the first of which is already operating. The second will be placed in service in a short time. These two engines will be called upon to operate in parallel on the electrical end. Parallel operation is particularly difficult in service of this kind on account of the violent fluctuations in load which occur, due to the size of the cars employed and the small number in operation at any particular time. As it is not possible to utilize storage batteries to absorb these fluctuations, the engines are called upon to sustain them and are thus put to the severest possible test occurring in the operation of electric power plants.

The two units installed are each of approximately 500 h. p. capacity direct connected to 260-kw., revolving-field, engine-type, single-phase generators. Each has two cylinders arranged in tandem fashion with a single crank. They will operate entirely upon natural gas distributed by a local company. In this district the gas has a calorific value of 1,000 B. t. u. per cubic foot. A 55-h. p. vertical Westinghouse engine of the single-acting type is also in operation driving air compressor and exciting unit for the main equipment.

Current is generated directly at a voltage suitable for transmission without the use of transformers. Transformer sub-stations are located along the right of way which reduce the line voltage to 3,300 volts for the trolley at which pressure it is collected by the cars.

The Warren & Jamestown Street Ry., although recently organized upon its present basis, has been running part of its present line for eleven years. Three years ago it began experimenting with gas power with sufficient success to induce the use of gas engines for the entire power generation.

A SPLICE FOR BROKEN TAPES.

The breakage of steel tapes is certain to happen no matter how much care is taken in handling them. These breakages are particularly frequent when a surveying party is pushing work as fast as possible, and the chainmen are consequently unable to be quite so particular with the tape as at other times. The mending of a



broken tape sometimes keeps a whole party idle for several hours, and to remedy this trouble the little device shown in the accompanying cut has been put on the market by Mr. Clinton B. Alexander, B. 26, Clearfield, Pa. It is a little sleeve in which the broken ends of the tape are inserted until they meet just under the sight-hole, where their proper position to prevent any alteration in the length of the tape can be observed. The screws are then turned down on the tape with the blade of a knife and the breakage is repaired. A number of these splices can be carried in the pocket without inconvenience.

THE NEW LINES OF THE CHICAGO & NORTH WESTERN RY.

The Chicago & Northwestern Railway Co. has under way important developments in Illinois, Wisconsin, Northern Michigan, South Dakota and Wyoming.

The first feature of these extensive plans is the construction of a line across Wyoming. This commonwealth has a large area that is without railway facilities. The western terminus of the Chicago & Northwestern Ry. in that State at present is Casper, the site of old Fort Casper on the North Platte River, and the extension which is now being built will carry the line directly across the central portion of Wyoming to the Big Horn River, across that stream and through what is at present the Wind River Indian Reservation to the beautiful Lander Valley, opening up thousands of square miles in the range country and furnishing railroad facilities to the Wind River Reservation, where more than a million acres of public lands will be thrown open to the homesteader by the Government next June.

Hardly less important is the new line across the western part of South Dakota, from Pierre, the State capital, to Rapid City on the eastern border of the Black Hills. The Chicago & Northwestern Ry. is the pioneer line to the Black Hills district, and the present line into the hills was begun almost as soon as the Indians had sold the territory to the Government. The new line across Dakota will effect a junction with the old line at Rapid City and will give Pierre and the range country an impetus beyond anything that has ever been done for that region. Deadwood and Lead in the mining district, Hot Springs to the south, and Belle Fourche, the big cattleshipping point to the north of the hills, will thus secure added railway facilities that will bring St. Paul, Minneapolis and Duluth, the Lake Superior iron and copper country, and the hardwood district of Wisconsin and Northern Michigan in closer touch than they have ever been.

Entirely different from the prairies of Dakota and the range country of Wyoming is this hardwood district of Northern Wisconsin and the Michigan Peninsula. Here the tracks of the Northwestern line join in close connection the industrial centers, the iron and copper district of Lake Superior, the scores of lake ports all the way from Milwaukee to Duluth, and the great tracts of timber land that are awaiting development and are filling up rapidly with settlers. In this region the Northwestern line is constructing several different branches, one northwest from Mercer; one from Manitowoc on Lake Michigan, through Green Bay, another important lake port, north into the heart of the hardwood district; another link extending from Laona, Wis., to the Menominee River at Saunders, Mich.; a branch line from Green Bay to Gillett, etc., etc. Some of these lines are already practically completed, all of them join older lines of the Chicago & Northwestern System, and each one promises to be an important factor in opening up the country

for unprecedented commercial growth. New towns are being opened on all of these newly constructed lines, and the railway's officers believe that merchants, bankers, farmers and business men will find a rare opportunity for investment in these new centers of western activity.

Illinois and Southern Wisconsin are interested in this construction work in two ways: First, by reason of the heavy interest that the merchants and manufacturers of such cities as Chicago, Milwaukee and smaller centers of industry will feel in the broadening and deepening of trade in the territory which is naturally tributary to them, and, second, by reason of the building and expansion of facilities of the Northwestern line for handling traffic. In this connection the work now being done between Chicago and Milwaukee forms one of the most interesting pieces of railway work at present under way in the United States. The two cities are about 80 miles apart and the new road, which will soon be completed, provides for a complete equipped, electric block signal, four-track line of railway between them. Something of the magnitude of the traffic between the two points may be gathered from the fact that the Northwestern line operates twenty-one fast passenger trains a day between them, a fast train for almost every hour in the day, and in addition thereto scores of local trains to take care of the traffic for a practically continuous chain of towns and cities along the shore of Lake Michigan.

BUSINESS METHODS IN JAPAN.

The Bureau of Manufactures of the U. S. Department of Commerce and Labor has issued the following statement concerning methods of doing business in Japan:

In order to meet the peculiarities of the Japanese trade and to maintain a thorough understanding of the desires of their patrons, each commission house employs one or more Japanese salesmen called "bantos." One chief banto, with various native assistants, is employed in each department of the business, while an American or European is in charge of the department and responsible to the head of the house for its administration. Without a banto, however, business in Japan would come to a standstill. Although the banto does not occupy the same relation to the business in all respects as the comprador in China, he is, nevertheless, quite as essential a factor. Even though the manager of a broker's house may speak Japanese fluently, as many do, he rarely undertakes the initial steps of a business transaction. The duty of the banto is to meet the Japanese merchant in his place of business, or when the merchant calls at the commission house to conduct the business, either buying or selling, to the point of closing the deal. All of the preliminaries, the great amount of talking and tea drinking which are a necessary preliminary to any transaction, are the portion of the banto. No effort is made by the broker to expedite matters, unless upon the suggestion of one of the natives. At the proper time he will be called upon to ratify the terms of the deal, or to accept or reject terms proposed by the merchant.

Methods of Business.—If a merchant desires goods furnished after some pattern or design submitted by him, he may call for bids and select the price most satisfactory, agreeing to pay the usual commission in addition; or, on the other hand, he may set his maximum price, when the broker will have to bring his commission and price within that figure. These are the usual methods of business in foreign trade pursued by the best-known commission houses, although purchases are made, when market prices seem to warrant, without orders from merchants upon the expectation of future orders at better prices, and some consignment business is also done.

When an order is placed the New York, London or Hamburg office, as the case may be, advises their representative in the East by cable of date of shipment, line, etc., and the shipper draws against the commission house at sight, or thirty, sixty or ninety days sight, according to previous agreement. The discounting bank takes the shipping documents—invoice, insurance policy and copy of bill of lading—making them a part of the draft which is forwarded for collection. By this arrangement payment of the draft is made prior to delivery of goods, or under such conditions as the bank may require. It is customary, however, for banks to permit delivery to be made at once upon the guaranty of the draft by the agent. The letter of credit is made use of by some to accompany each order, but this is not the preferred method.

Lighterage and Other Charges.—As all ships except those of light draft anchor offshore, landing and shipping agents are employed to deliver merchandise from ship to customs house and furnish the necessary lighters and coolies to perform this service. A fixed charge is made for each package or case, which ranges from 4 sen (2

cents) to 18 sen (9 cents) for bags, cases, crates, bales, baskets, etc., up to a picul in weight, while measured tons range from 60 sen (30 cents) to 1 yen (50 cents), and tons by weight are from 65 sen (32½ cents) to 1.25 yen (62½ cents). These charges are borne by the consignee or agent, and have to be computed by him in fixing prices on imports.

Advantage of Small Packages.—In shipping small packages or in shipments amounting to 50 pounds or as much as 100 pounds, where the nature of the merchandise is such as to admit of its division into 4-pound packages, a most satisfactory method to be pursued is by means of parcels post. The rate by this means is 12 cents per pound, with a maximum of 4 pounds 6 ounces. At this rate shipments may be made from any point in the United States to any point in Japan and to the ports of China and Korea, and in fact to any country in the Postal Union. An additional charge of 8 cents per package insures safe delivery by registration. Delays incident to the landing of cargoes, fees, etc., in passing the customs, and other charges are avoided by making use of the parcels post, and in light, bulky articles a great saving in transportation charges is made. The many advantages and economies of this system of shipment are well worth the careful study of American exporters. When the nature of the goods is such as to preclude division into small packages to admit of sending by parcels post, parcel freight rates may be obtained through shipping brokers in America. A rate of \$1.75 per 100 pounds is obtainable from central points in America to Kobe, Japan.

Footwear and Leather.—Below are given some of the articles of import arriving at Kobe, showing the countries from which they come and the main reasons which influence their purchase in their present markets:

Shoes sold in Kobe are almost entirely of native makes. The styles are copied from English and American shoes imported for that purpose, the former styles predominating, though far more unsightly and uncomfortable in appearance and fit than American lasts. The Japanese use American leather almost entirely in their best shoes, as it gives the best results. English leather has been competing more strongly of late, their prices being about the same as American and German. The Japanese are engaging in tanning to a greater extent each year, but their standard is not yet up to the imported article. The wearing qualities and appearance of Japanese leather is much inferior to the imported article and is used only in the cheaper grades of shoes. Prices of shoes range along with those popularly prevailing in America, but not quite so high in the better qualities. Good hand-made shoes of American leathers can be obtained for 4.50 yen (\$2.25) to 6.50 yen (\$3.25). The best shoes carried in some stores sell for 7.50 yen (\$3.75), while vici kid shoes can be obtained for 6.50 yen (\$3.25) per pair. Children's shoes can be obtained for from 35 sen (17½ cents) to 1.80 yen (90 cents) per pair. For the prices asked these shoes offer good values. German-made rubber shoes are offered in about the same quantities and sizes as American makes, at prices that are practically the same for each. Prices range from 95 sen to 2 yen (47½ cents to \$1) per pair. Tennis shoes may be obtained from 1.60 yen (80 cents) upward.

Drugs and Chemicals.—The standard required in Japan for drugs and chemicals is the Pharmacopœia Germanica, fourth edition. In all tests and analyses made of imported chemicals and drugs a strict technical compliance with the requirement is observed. This rigid interpretation of the German standard has led to the rejection of chemicals received from America, which for all practical purposes have conformed to the United States Pharmacopœia, a standard equally exacting. Notice should be taken by manufacturing pharmacists in America of this technical requirement. Germany supplies the bulk of the fine drugs and chemicals in this market, while much of the heavy chemicals come from England. The fact that prices offered by English concerns are much lower than those by American houses is sufficient reason for purchase in that market. As a fair illustration of the relation between prices it may be stated that carbolic acid is quoted by a large American drug house at 26 cents per pound in 50-pound cans, while an English concern quotes 13 cents. Acetic acid is offered at 10 cents per pound by manufacturers from both countries. From these prices English concerns give discounts of 2, 5 and even 10 per cent., with an alternative of extended time on the quoted price, and Americans allow no discounts, requiring cash with each order. Borax is consumed to a considerable extent, but England and Germany divide the market of \$25,000 annually between themselves. With prices averaging around £12 10s. per ton f. o. b., London, it would seem that from the almost limitless output of this product in America this market could readily be supplied.

Stationary and Turbine Engines.—Stationary engines for cotton mills are in most cases purchased in England. The original purchases of stationary engines were made in England with feed pump, air pump and condenser directly connected. This is not a present-day American principle, and though the American type may possess many advantages over the English engine the conservatism of the Japanese holds strongly to the original style,

and to the present no great headway has been made in changing his desire for this kind of engine.

Steam turbines from America have been introduced of late with much success and a good field will open for such machines in the near future. Machine tools, lathes, planers, shapers, plate rollers, steam hammers, etc., of the heavier types come mostly from England, while the smaller sizes of American make are most preferred. The question of price and quickness of delivery appear to be influencing factors in these lines. Notwithstanding the reputed ability of American concerns to effect quick delivery of manufactures in iron and steel, on a recent large order of machine tools the time quoted from America was fourteen months, while English manufacturers agreed on delivery in eight months.

Iron nails are shipped in kegs holding a picul each, and are sold at a flat price irrespective of quotations on different sizes. The prevailing prices are 6 yen (\$3) to 6.50 yen (\$3.25) per picul. Through Kobe there are shipped nails to the value of about \$50,000 each month, according to the customs returns, while the entire purchases of the Empire during 1904 amounted to over \$900,000.

Paper-Making.—Wood pulp, both sulphite and mechanical, are used in Japan in paper making, which is carried on to a great extent in Osaka, Tokio, Nagoya, Yokohama, and Tosa, in Kiushiu Island. Not only is paper manufactured in these cities, where machine power is largely employed, but throughout the Empire there are centers or districts the residents of which are in great numbers devoted to paper making. In these places the industry is carried on by hand power. The Japanese Government is conducting experiments in wood pulp making, and is producing some sulphite wood pulp in the northern part of Hokkaido. To the present the results have no commercial value, however, and the output is of a very inferior quality.

Sulphite wood pulp is used in larger quantities than mechanical, and comes almost entirely from the Germans, though obtained by them from Norway and Sweden. England furnishes a small portion, while that from America is almost all mechanical wood pulp. The demand for wood pulp has been increasing during the last four or five years, and there should be a good market for the American article, especially from the Pacific coast. The nearness of this market to the Pacific slope States ought to enable American manufacturers of that region to completely control this commodity.

Manufactures of Steel.—Although there is a preference for American-made steel plates, there are very few of them sold here, as the prices quoted on all orders are from 5 to 6 per cent. higher than those received from English manufacturers. In gas and boiler tubes the American prices average about the same as those from other countries, with the result that our manufacturers are favored with a good share of this business. There is a steady and large demand throughout the entire country for wire nails of all sizes, and large orders are regularly placed by Japanese merchants upon a somewhat different plan than usually pursued. Supplies of 5,000 or 6,000 kegs of nails are purchased at times when the market is favorable. These orders are placed at intervals of two months or thereabouts and are on a speculative basis, the Japanese merchant relying on the fluctuations of the market to obtain his profits instead of fixing upon a certain advance of his purchase price when selling to his patrons.

Wire Nails, Galvanized and Corrugated Iron.—Wire nails at present come mostly from Germany, although in the past American nails were in the majority. The speculation by the Japanese on the future prices of nails operates somewhat against the American product, as they seldom calculate on the market over two months ahead. Shipments from America via Suez take about three months by tramp freighters, and from Hamburg or Liverpool about two months. The price quotations would therefore have to be quite favorable in this commodity to offset the advantages obtained by this difference in time of delivery.

Galvanized corrugated-iron sheets come from England principally, although Germany sells a small portion. Immense quantities are used, and the consumption is steadily increasing. At prices averaging 250 pence per picul American manufacturers do not compete. It is said that there has been no shipment of corrugated galvanized-iron sheets from America for over five years. In plain galvanized-iron sheets, however, a portion are bought in America, but the greater part of them come from England at prices in the neighborhood of 270 pence per picul. These sheets enter largely into the production of articles for domestic purposes, and their standard must be high to meet the wishes of their users.

Glass.—There is a steadily increasing use of window glass in stores and residences of every city, displacing to a great degree the thin Japanese paper window lights. This is noticeable even in the houses of the poorer classes, while the wealthier people in many instances have their houses fitted with glass windows to as great an extent as will be found in American houses. In small towns and farming districts window glass is used to a very considerable extent. To the present time almost the entire supply of this commodity is obtained from Bel-

gium. In fact so indifferent are American glass manufacturers felt to be toward this market that requests are seldom made for prices except in England and Europe. It would seem that a market worth annually over \$350,000 in window glass and \$100,000 in plate glass and glass manufactures would offer some attraction to American manufacturers.

The manufactures of glass in Japan consist for the most part of beer and other bottles, lamp chimneys and shades, drinking glasses, cut glass and a small amount of window glass. This last-named article has not been satisfactory, as the glass is not as yet made sufficiently clear for commercial purposes. Glass works exist principally in Osaka and Tokio on a large scale, Osaka having about 20 plants, with from 30 to 200 operatives. Throughout the Empire there are families engaged in glass blowing whose output of lamp chimneys, shades and bottles goes to supply the communities in their immediate vicinity.

British Vigilance.—In such staples as pig iron, channels, joists, angles and pipes for steam and boiler purposes, this market is kept in close touch with prices in England by regular weekly cables. These quotations are generally received each Tuesday morning, and orders received in England during the following three days are promptly filled. Orders are taken during the remaining days subject to cable approval from London. This method of weekly quotations is not pursued by American houses, but by this close attention to the market in Japan England has been able to maintain a lead in many large lines far in advance of all other countries. Such methods produce a further result in that the names with whom the consumer has become acquainted are often the only ones to whom he will permit his specifications to be submitted when special contracts are to be considered. In one particular contract shown me, amounting to close upon \$100,000, many items of which could have been furnished by American manufacturers, bids were requested in England, Germany and France. The request was confined to manufacturers of those countries simply because of previous experience with their products.

Indifference of American Manufacturers.—Hesitancy is also felt about submitting requests for bids on parts of orders to American concerns when manufacturers of other countries have been furnishing similar goods with satisfaction. Should there be a failure to properly comply with the requirements of specifications, importers know that the regular exporter has a well-defined interest in maintaining his name in the foreign market, while the one who at irregular intervals bids to supply orders may be as indifferent to the proper filling of the order as he is to the market itself. Every effort is made by exporters whose interests are in the foreign market to rectify any irregularity, while the experience with the transitory exporter is quite to the contrary. The sentiment here is, general that until the American manufacturer feels the need for competing in the foreign market at all times, abandons his attitude of indifference toward that field, and is ready to earnestly and seriously consider its needs with the purpose of catering to them at all times, the bulk of the trade will go to other countries, where an unceasing study is made to cater to the wants and peculiarities. In short, when the American manufacturer concludes to treat the foreign buyer on somewhat the same plane as he does his good patron at home he will be able to reap a large reward for his attention in increased sales in this market.

THE CONCRETE ASSOCIATION.

On the evening of Nov. 2 there was a meeting in the rooms of the Building Trades Employers' Association of members of some fifty or more important concerns representing the several divisions of the concrete industry and allied arts. The result of this meeting is the formation of The Concrete Association, a body that is likely to assume national consequence, so widely distributed throughout the country, and so varied and powerful are the interests for which it will stand, and of such vital import are the principles it will seek to establish, and the measures it will advocate.

It will strive to effect legislation that will promote the interests alike of the trades concerned, of property owners and of municipalities; to standardize concrete construction methods; to reconcile the differences between buildings departments, insurance underwriters and the concrete industries, and to secure for the latter full recognition of their economic value. It hopes to enroll members from all over the United States, or to prove the nucleus for associate bodies of similar character therein.

It plans erecting eventually a fine twenty-story reinforced concrete building, which will not only house all the building trades associations, but will provide offices that, in number and kind, will prove an inducement to the members of building trades to concentrate under one roof, and thus facilitate their own business, and that architects, engineers and all others having relations with them.

Here, too, will be installed an exhibition, to comprise specimens of machinery, material, appliances and devices, models, the best examples of approved practice in concrete construction, and all other things pertaining to, or used in the concrete industry; also bureaus of infor-

mation, statistics, etc., wherein all interests it in any way affects can be sure of finding the latest and most comprehensive data, and will, therefore, have to visit it—from no matter what distances—that they may develop their enterprises along the best lines.

The following gentlemen, representing the various divisions of the industry, were elected as officers of The Concrete Association: Ross F. Tucker, reinforced concrete, president; H. C. Turner, reinforced concrete, first vice-president; H. C. Miller, manufacturers steel reinforcing members, second vice-president; W. W. Benson, artificial stone manufacturers, third vice-president; T. G. Barr, cement manufacturers, secretary, and Ronald Taylor, paving manufacturers, treasurer.

That in the comparatively short time it has been in existence this industry has achieved so important a place in the building trades, and in the estimation of architects, engineers and owners amply testifies to the inherent worth of the principle and practice of its method of construction, and also fully justifies the early and, what its leading members have courteously termed, effective recognition extended it by this paper.

THE RANSOME FLOOR SURFACING MACHINE.

A simple machine for surfacing wood, concrete, tile, marble, or other floors is shown in the accompanying illustration. It consists of a framework mounted on ball-bearing casters, and supporting an electric motor of 1½ h.p., that drives a revolving disc. This disc is faced

ished with this machine better than can be done by hand work. Wax can be applied and brought to a high polish by covering the revolving disc with cloth. It will thus be seen that the machine is adapted for use not only as a surfacer of new floors, but as a polisher of old floors.

The surfacer is manufactured by the Ransome Concrete Machinery Co., 11 Broadway, New York.

THE DEEPWATER-TIDEWATER R. R.

The announcement that the whole Deepwater-Tidewater R. R. project will be pushed to completion as rapidly as possible, the contracts all giving but 2 years' time for construction, attracts attention again to this interesting enterprise. Nominally it is intended as a coal road, to develop the rich fields of West Virginia lying between the Chesapeake & Ohio and the Norfolk & Western systems. It will run from Deepwater at the head of navigation on the Kanawha River to Sewells Point, 8 miles below Norfolk, and will have a total length of 460 miles. The coal fields reached by the road are the Kanawha, New River, Pocahontas and others almost as prominent, and about 3,000 square miles of virgin coal properties will be opened up. The portion of the road in Virginia is chartered as the Tidewater R. R. and that in West Virginia as the Deepwater R. R. On the 460 miles from Deepwater to Sewells Point, considerable progress has been made in grading and track laying at both ends of the line. On 105 miles of the road 35 per cent. is graded.*



MACHINE FOR SURFACING WOOD AND CONCRETE FLOORS.

with emery, carborundum or sandpaper, where it is desired to surface a hardwood floor but, for surfacing concrete, marble or stone, a wire brush may be substituted for the emery disc. Surrounding the disc is a hood (shown partly open in the illustration), from which a pipe leads to a bag that receives the dust. A small suction fan, belted to the motor, serves to suck up the dust from the hood. It will be noted that the motor is mounted on an upright gallow frame which swings upon a hinged joint at its lower end, and that a pair of coiled springs serve to counterbalance the weight of the projecting arm that carries the revolving disc, so that when the machine is not in operation these springs raise the projecting arm so that the disc does not touch the floor. By means of a handle, a man can press the disc down upon the floor with just as little or as much force as desired; moreover, he can swing the projecting arm right or left, because it is pivoted so as to permit motion in either direction; and he can move the whole machine from place to place as easily as a carpet sweeper is moved. The electric current that runs the machine is usually obtained from the street circuit; but a little electric generator driven by a gasoline engine can be used to supply the small amount of power required.

While this is the latest model of the Ransome floor surfacer, and is greatly simplified, it should be stated that an earlier model was used for surfacing eight acres of hardwood floor in the Potter Hotel, Santa Barbara, Cal. The floors of Hotel Green, at Pasadena, were also surfaced with this machine, and the floors of numerous residences have been surfaced at a remarkably low cost with the surfacer.

Since one operator, using this machine, does the work of about eight skilled men, it is obvious that, wherever electricity is available, hand work can no longer compete with the machine. Any floor, new or old, which can be surfaced or polished by hand, can be surfaced or pol-

ished with this machine better than can be done by hand work. Wax can be applied and brought to a high polish by covering the revolving disc with cloth. It will thus be seen that the machine is adapted for use not only as a surfacer of new floors, but as a polisher of old floors.

In the aggregate some 40 miles of track has been laid, and about 34 miles is in operation. It is expected that during the next 12 months approximately \$13,000,000 will be paid out on construction account. The road is built with broken stone ballast and 85-lb. rails. Tunnels are 22 ft. above the rail. Of course this new system plans for cheap transportation; consequently, the route from Sewells Point to Deepwater was selected with reference to such favorable grades as are consistent with shortness of distance. The road, from the main yards at Princeton, in Mercer county, to tidewater, will have no grade greater than 25 ft. to the mile; 8 miles of 25-ft. grade will be necessary to cross the Alleghenies. The main part of the line will have nothing greater than a 7½-ft. grade, or 0.2 per cent. compensated for curvature, practically a level road. The total lift of the Deepwater-Tidewater is only about 1,000 ft., while on the Norfolk & Western it is 4,000 ft., the larger portion of which has grades of 50 ft. and over to the mile.

The tidewater terminal of this new system has certain advantages. The railroad owns 520 acres of ground at Sewells Point, with a deep-water frontage of 3,300 ft. The land selected for a terminal is opposite the holding ground of Hampton Roads for all vessels; the channel is unobstructed, and there is open water to the piers at low tide.*

The aggregate capitalization of the Deepwater-Tidewater railroad amounts to only \$175,000, and yet construction is contracted involving an outlay of millions. The road is being built and paid for without asking anyone to buy a bond. No county is requested to subscribe for stock. On the other hand, an expensive right-of-way has been bought. Of the Deepwater Ry., J. O. Green, of New York, is president; G. W. Imboden is vice-president, and R. C. Taylor, secretary, both of Ansted, W. Va. The Tidewater Ry. has the following officers: W. N. Page,

president; T. D. Ranson, vice-president, and H. J. Taylor, secretary, of Staunton, Va. For both roads, the treasurer is G. H. Church, of New York; H. Fernstrom is chief engineer; the general manager is Raymond Du Puy.

THE IRON AND STEEL SITUATION.

October will go down in the history of the iron industry for record breaking. The monthly statistics of *The Iron Age* show that there were produced by the anthracite and coke furnaces of the United States 2,053,127 tons of pig iron, which compares with the previous achievement of 1,963,717 tons in May. These figures do not include the output of charcoal pig, which may be estimated at about 30,000 tons a month. The steel companies produced 1,370,960 tons in October, as compared with 1,287,438 tons in May. Of this October product the United States Steel Corporation has 950,752 tons. The Carnegie Steel Co. in October broke 78 past records of production at its furnaces and mills, not counting turn and day records which would greatly add to the number. Thus the Edgar Thomson rail mill made in October 83,568 tons of steel rails. How enormous the output of the steel works is is proved by the record of the plants of the United States Steel Corporation, which in October produced 1,172,951 gross tons of ingots.

The pig iron markets throughout the country are exceedingly firm, and the conviction seems to be gaining ground that further advances are inevitable. Production, however, is at an enormous rate, statistics showing that on Nov. 1 coke and anthracite furnaces having a capacity of 460,000 tons weekly were in operation.

It is understood that the Bessemer Association has shown little disposition to meet the requirement of the Steel Corporation for an option on 15,000 tons of pig iron monthly for the first quarter of the year, the total quantity of association iron available for that period being only 57,000 tons. There are reports of further sales of basic iron in the Eastern markets, but much of these appear to have been made some time since. There has been some heavy buying of forge, foundry and malleable iron in New York State from Albany and Troy westward, the bulk of it going to Buffalo furnaces, which have again advanced their prices to the basis of \$17 at furnace No. 2. Southern furnaces are now squarely on the basis of \$14 for No. 2 Foundry at Birmingham, but have made only moderate sales lately, being heavily booked. The demand continues heavy, considering the enormous purchases made during the past two months. Among the large interests which are again in the market may be noted the cast iron pipe industry. Moderate sales of steel rails are reported, with some further heavy contracting in sight. Light rails have again advanced \$1 per ton. Plate makers are again urging the necessity for higher official prices and this may come at an early date. The demand for sheets is good, but prices show no improvement. In the tin plate trade the leading interest has opposed an advance. The pressure for deliveries in the structural trade is enormous. Two contracts for buildings for Chicago calling for about 15,000 tons were let during the week. In the merchant pipe trade the most interesting feature is an inquiry for 600 miles of 6-in. pipe for an oil line from Kansas City to St. Louis.

BUSINESS NOTES.

The Duff Mfg. Co., Pittsburg, has been awarded the gold medal, highest award, for the Barrett track and car jacks at the Lewis and Clark Exposition. The Barrett jacks were also awarded the gold medal at the Louisiana Purchase Exposition, St. Louis, 1904.

There were 100 steel cars to be built for the London Metropolitan Ry., when it was decided to convert the system to electric power. The contract for these cars was secured by the American Car & Foundry Co. under conditions demanding the highest possible speed of construction, and this fact called for the best of tools and most up-to-date manufacturing equipment. The work to be done called for a great number of pneumatic tools, and since the contract covered only a short period, the plant installed was necessarily temporary in character. The order for the complete pneumatic equipment was placed with the Ingersoll-Sergeant Drill Co., of New York and London, and the appliances furnished are of the company's standard types. The tool equipment proper included eighteen 8-in. and twenty-five 5-in. Haeseler riveting hammers, and sixteen No. 7 and twenty-four No. 12 Haeseler rotary drills. The four air compressors are of the builder's class JC duplex two-stage machines of balanced type, with a heavy inside fly-wheel, solid sub-base, and semi-tangye frames. Air cylinders are completely water-jacketed on heads and barrels, with an intercooler in the sub-base. The Sergeant piston inlet air valve is applied on both cylinders and discharge valves are of vertical lift direct-discharge pattern. At the rated speed of 10 r.p.m., each compressor has a displacement of 526 cu. ft., giving a total free air capacity to the plant of 2,104 cu. ft. per minute, which is delivered at a pressure of 80 lb. Each unit is belted to a direct-current British Westinghouse motor rated at 110 h.p. on 550 r.p.m. Standard automatic choking controllers on the compressors maintain pressure and regulate output as load varies.

Mr. Walter Loring Webb, Land Title Bldg., Philadelphia, reports the sale of a large quantity of Johnson corrugated bars for reinforced concrete construction. McCormick & Co., Philadelphia, have taken 150 tons for the concrete flooring of $3\frac{1}{2}$ miles of the Market St. elevated railway in that city; orders have been placed for bars for 40-ft. girders carrying heavy loads in the Hotel Dennis, Atlantic City; the Smedley Construction Co., Philadelphia, has ordered bars for a reinforced concrete building for the new power station of the Harlan & Hollingsworth Corporation, Wilmington, a structure designed by Mr. Webb; the American Railways Co. are using the bars in a bridge and dam in a park near Altoona; and the Berwind-White Coal Mining Co. are using the bars in reinforcing the concrete floors of a power house.

A large steel frame building will be erected at Economy, Pa., for the National Metal Moulding Co., by Wm. B. Scaife & Sons Co., Pittsburgh, Pa.

The Wellman-Seaver-Morgan Co., Cleveland, has received an order from the U. S. government for crane service over two shipbuilding booths at the Mare Island Navy Yard. This is the most important contract of its kind for some time, comprising a large steel trestle and a powerful highspeed cantilever gantry crane.

The Technical Publicity Association held its annual meeting on Nov. 3, when the following officers were elected: President, C. B. Morse, Ingersoll-Rand Drill Co.; vice-presidents, H. M. Cleaver, Niles-Bement-Pond Co., Frank H. Gale, General Electric Co.; secretary, Rodman Gilder, Crocker-Wheeler Co.; treasurer, H. M. Davis, Sprague Electric Co.; executive committee, Graham Smith, lately with the Westinghouse companies, and Charles M. Manfred, H. W. Johns-Manville Co. Mr. Davis addressed the association on "The Advertising Appropriation," and an informal discussion followed in which the members exchanged views on the disposition of advertising appropriations, the relative amount that should be spent in magazine and circular advertising, the relation between the advertising appropriation and the volume of business, and related topics.

Owing to the rapidly increasing Southern business of the De La Vergne Machine Co., of New York, it has established a branch agency at Atlanta, Ga., in charge of Mr. W. M. Hargreaves, whose offices will be in the Candler Bldg. This agency will cover North and South Carolina, Alabama, Florida and Georgia, and will handle the company's business in refrigerating and ice machinery, Hornsby-Akroyd oil engines and Koerting gas engines.

The Robins Conveying Belt Co., 21 Park Row, New York, has just closed a contract with Bartlett, Hayward & Co., Baltimore, for belt conveyors for the retort house of the Astoria Light, Heat & Power Co. Among other work this company now has on hand is the manufacture of belt conveyors and elevators for the Burnham Coal Co., Boston, and for the U. S. Smelting Co., Salt Lake City.

The S. Morgan Smith Co., York, Pa., is furnishing the International Paper Co. for its power plant at Livermore Falls, Me., six pairs of turbines, each pair to develop over 1,300 h.p. under 32 ft. head, and a small wheel to drive an exciter. The company is also furnishing to the American Optical Co., Southbridge, Mass., two pairs of turbines to develop 500 h.p. under 11 ft. head. The speed of each pair of wheels is controlled by a Lombard governor, the arrangement being such that either pair of wheels, which are in separate power houses, with a steam plant in still another location, can be controlled from the switchboard in the engine room. The S. Morgan Smith Co. is also installing for the Otis Fibre Board Co., Russell, Mass., two pairs of horizontal wheels, each to develop 400 h.p. under 22 ft. head. This installation is unusual from the fact that the wheels and generators will be inside the dam, the wheels setting in concrete flumes and the walls of the generator room being water-tight construction. The wheel pits and tail races are formed by arches below the dam.

The Broderick & Bascom Co., St. Louis, has opened a branch house at 19 Murray St., New York City, for the sale of "Power" rope and other specialties.

The Foss Gas Engine Co., Springfield, Ohio, has received a gold medal from the Lewis and Clark Exposition for "the best single cylinder horizontal gas engine." The company states that the volume of business on hand is so great that it is contemplating an addition to its works.

The Bucyrus Co., South Milwaukee, Wis., is building 61 steam shovels, three railroad wrecking cranes and a railroad pile driver for work at Panama.

The Hunt Engineering Co., Independence, Kan., has begun the construction of a 2,500-bbl. Portland cement plant, 6 miles from Independence. The plant will be located on the side of a limestone and shale hill, which will permit handling the materials by gravity to a considerable extent. Gates crushers, water-tube boilers and Corliss engines will be installed.

The Westinghouse Machine Co., of East Pittsburgh, Pa., has within the last few weeks received numerous orders for turbines, among them being one from the Lumberton Cotton Mills, Lumberton, N. C., for one 300-kw. turbine; from the Waltham Gas Light Co., Waltham, Mass., for four 500-kw. turbines; from the Gulfport &

Mississippi Coast Traction Co., Gulfport, Miss., for two 500-kw. turbines; from the Suburban Electric Co., Seranton, Pa., for one 500-kw. turbine; from the Pennsylvania Light & Power Co., Pittsburg, Pa., for one 500-kw. turbine; from the Water, Light & Gas Co., Hutchinson, Kan., for one 500-kw. turbine; and from the Winston-Salem Power Co., Winston-Salem, N. C., for one 750-kw. turbine. The turbine ordered by the Lumberton Cotton Mills will drive a 60-cycle, direct-connected generator running at 3,600 r.p.m. It will operate at 150 lb. steam pressure and 26 in. vacuum, and deliver three-phase current at 440 volts. The turbines for the Waltham Gas Light Co. will be of the same type and frequency, operating at 3,600 r.p.m. with dry saturated steam at 175 lb. pressure and 28 in. vacuum. The alternating-current generators will be of the rotating field turbo type delivering three-phase current at 2,300 volts. The Suburban Electric Co.'s turbine with characteristics similar to the above will operate with dry saturated steam at the throttle of 150 lb. pressure and with atmospheric pressure in exhaust-pipe, and will be capable of developing 750 b. h. p. The turbines for the Gulfport & Mississippi Coast Traction Co. will operate under 150 lb. pressure, 28 in. vacuum and 100° Fahr. superheat, and will be direct connected to 60-cycle generators running at 3,600 r.p.m.

PERSONAL NOTES.

Mr. H. H. Westinghouse has been elected one of the trustees of Cornell University.

Mr. John B. Shannon has been appointed superintendent of the Consolidated Water Co., at Carbondale, Pa.

Mr. E. M. Spalding, of Milwaukee, Wis., has been appointed chief engineer of the Milwaukee Southern R. R.

Mr. Charles A. Bogardus has been elected superintendent of the water-works of Chicopee, Mass.

Mr. Colin R. Wise, M. Am. Soc. C. E., of Passaic, N. J., has been elected a member of the New Jersey Assembly.

Mr. L. Strom has been appointed master mechanic of the Mexican Central Ry., at Mexico, succeeded Mr. C. H. Burk, transferred to a similar position at Chihuahua.

Mr. Eduardo Otero has opened an office at 2 Facon St., Havana, as agent for machinery in Cuba, particularly equipment for sugar estates.

The river protection of the Missouri Pacific Ry. has been placed in charge of Mr. Charles H. Miller, whose office will be in St. Louis.

The construction work on the Canadian Northern Ry., west of Edmonton, Alta., has been placed in charge of Mr. A. J. Rossar, resident engineer.

Mr. L. B. Merriam has been made resident engineer of the Wyoming Division of the Union Pacific Ry., in charge of double-tracking between Green River and Cheyenne, Wyo. His office will be at the latter city.

Mr. Charles L. Ruffin has resigned his position as assistant roadmaster of the Richmond, Fredericksburg & Potomac R. R. to become a division engineer on the South & Western R. R.

Mr. Walter G. Tubby, general storekeeper of the Great Northern Ry., has been appointed chief of the division of supplies of the Isthmian Canal Commission, with headquarters at Cristobal, Canal Zone.

The address of M. Meemann, chief engineer of Paris, and director-general of the North-South Underground Electric Ry., in that city, has been changed to 68 Rue Pierre-Charron.

Mr. A. P. Peck, a graduate of Purdue University, who has been electrical sales agent of the National Electric Co. for about three years, has become connected with the New York office of the Allis-Chalmers Co.

Mr. P. N. Jones, formerly with Westinghouse interests in Pittsburgh, has been appointed mechanical engineer of the Pittsburgh Railways Co., in charge of power houses and machinery.

Mr. L. B. Stillwell has been appointed consulting electrical engineer of the New York, Westchester & Boston Ry. Co. Mr. H. S. Putnam has been appointed electrical engineer of the company, in charge of the electrical department of the chief engineer's office.

Mr. Robert Howes, assistant general manager of the Washington Water Power Co., of Spokane, has been appointed first assistant general manager and superintendent of construction of the Great Northern Power Co., of Duluth.

Mr. J. M. Graham, fourth vice-president of the Erie R. R., under whose direction the electrification of portions of that company's lines will be executed, has recently returned from a visit to the electric railway in Northern Italy operated by the Ganz three-phase system.

Mr. E. A. Williams has been transferred from the position of assistant general manager of the Erie R. R. to that of general superintendent of motive power. Mr. J. H. Manning, formerly with the Delaware & Hudson Co., has been appointed mechanical superintendent of the western lines of the Erie R. R.

Mr. R. W. Hutchinson, Jr., author of several books on power development, transmission and application,

has joined the firm of Joseph M. Roman & Co., New York City, which has made a specialty of the design and construction of electric and power propositions. The firm has opened an office at Atlanta, Ga., in order to follow its work in the South more closely.

Mr. A. P. Valentine, Jr., a Philadelphia architect connected with government work at the League Island navy yard for the last six years, has been appointed assistant structural engineer in the Bureau of Building Inspection of Philadelphia. This appointment was made as the result of an open competitive civil service examination.

Mr. W. B. Bogardus, president and chief engineer of the Peninsular Engineering & Construction Co., of Jackson, Mich., died in Spokane on Nov. 1. He was graduated from Sibley College, Cornell University, and for the last nine years made a specialty of cement works construction, being closely associated with the Cowham interests.

Mr. Max Toltz, vice-president and general manager of the Manistee & Grand Rapids R. R., will visit Great Britain, France, Belgium, Germany, Austria and Italy investigating railway economics for Mr. James J. Hill. Until two years ago he was mechanical engineer of the Great Northern Ry., which he left to supervise the construction of the Canadian Pacific elevators at Montreal.

Mr. Leo E. Granke, of the U. S. Reclamation Service, has been transferred from the Milk River project in Montana to the Lower Yellowstone project in Montana and North Dakota. Mr. W. P. Hardesty, assistant engineer, has been transferred to Hazen, Nev., and Mr. Geo. O. Sanford has been transferred to the Lower Yellowstone project.

Mr. C. W. A. Koelbecke, mechanical engineer for the last four years with the Garrett-Cromwell Engineering Co., and for ten years before that with Mr. Julian Kennedy, has joined the engineering staff of the Wellman-Seaver-Morgan Co., of Cleveland, where his attention will be given to blast furnace, steel plant and rolling mill construction.

Mr. John Ericson last week resigned the office of city engineer of Chicago, but, at the request of the Commissioner of Public Works, he has withdrawn this resignation and consented to serve as consulting engineer for a year, being relieved from the detail management of the office by Mr. W. A. Shaw. The administration of the Chicago engineering work by Mr. Ericson during his term of office, under extremely trying conditions, has attracted much attention for its efficiency, and the arrangement by which the city will have the benefit of his advice while he is taking a well-earned rest is decidedly fortunate for the taxpayers.

An examination will be held by the U. S. Civil Service Commission at all the large cities of the country on Dec. 6 of candidates for positions as mechanical draftsmen under the Isthmian Canal Commission on the Canal Zone, at salaries of \$1,200 to \$1,800. The subjects of the examination and their respective weights are as follows: Mathematics, comprising arithmetic, algebra through quadratic equations, geometry, mensuration, logarithmic computations, elementary mechanics, the use of the slide rule, and the interpretation of formulas, 25; drawing, 25; the materials used in machine construction, 15; training and experience. Further information can be obtained by addressing the Commission at Washington.

Mr. Calvin W. Hendricks, who has been appointed chief engineer of the Baltimore Sewerage Commission, was born in Paducah, Ky., in 1865. When 16 years old he began work on the engineering corps of the Chesapeake & Ohio Southwestern Ry. Two years later he became a transitman and inspector of pavements in Louisville, where he remained until 1887, when he received an appointment as assistant engineer on the construction of the Georgia Southern & Florida Ry. From 1888 to 1894 he was city engineer of Macon, Ga., and also engaged in other work. From 1895 to 1898 he was an assistant engineer on the staff of Mr. William Barclay Parsons, preparing plans for the Rapid Transit R. R. Commission, and later was appointed engineer of sewers in the Engineering Department of the Commission. The duties of this office required the reconstruction of many miles of sewers, often under unusual conditions presenting serious difficulties, described in a number of articles in past issues of this journal.

TRADE PUBLICATIONS.

Some excellent illustrations of the Charley Creek bridge at Wabash, Ind., are given in a folder from the Trussed Concrete Steel Co., Detroit. This has two reinforced concrete arches of 75 ft. clear span each, the total length of the bridge being 240 ft. The curve of the intrados of the arch is a parabola of 18 ft. rise; the thickness of the arch at the crown is 18 in., and at the haunches 3 ft. 4 in.

Owners and designers of industrial plants will find in catalogue 11B of the Ernst Wiener Co., 68 Broad St., New York, not only illustrated descriptions of track, turntables, frogs, switches, crossings and steel and wood cars for ore, coal, concrete, etc., but also many pages of useful tables and information relating to narrow-gauge railways.

The new catalogue of electric mine locomotives, issued by the Jeffrey Mfg. Co., of Columbus, is a profusely illustrated book of 68 pp. The company made its first installation of this sort in 1889, and since then has furnished many equipments of this class, one of its most interesting outfits being that used in the tunnel under the streets of Chicago. The details of design and construction of many types of these locomotives are described in this catalogue, and special sections are devoted to rack locomotives and those operated by storage batteries.

The protection of piles against the teredo is a very serious problem in so many localities that a pamphlet from the Lock Joint Pipe Co., 346 Broadway, New York, describing a concrete covering for the purpose will doubtless interest many readers. The lock pipe consists of half pipes which can be placed around a pile, locked together, and then filed with sand. In this way piles in a competed structure can be protected easily should they show signs of injury.

A valuable book on the characteristics and construction of rotary converters, with instructions for their erection, operation and care, has been issued by the Westinghouse Electric & Mfg. Co. While it is, in a sense, a trade publication, it is also a useful engineering manual for any engineer engaged in electric power transmission.

The latest section of the general catalogue which is being issued by Warren Webster & Co., Camden, N. J., contains a description of a water-seal motor. This interesting device is used only with the Webster heating system and is employed to control the discharge of the air and water of condensation from the heating surfaces, without the loss of steam.

The Shultz Belting Co., St. Louis, Mo., has condensed in a 16-page booklet a large amount of valuable data concerning leather belting, belt cement and dressing, and oil extracting powder.

The Allis-Chalmers Co., Milwaukee, Wis., has lately completed a number of new bulletins. No. 1608 describes a line of motor-driven single-stage centrifugal pumps designed particularly for use as circulating pumps for condensers and hot-water heating systems, manufacturing plants, irrigation and service of like character. No. 1404 describes the McDougall roasting furnace with enclosed fire-box, which is built to roast 30 to 100 tons of heavy sulphide ores in 24 hours. No. 1403 is a description of the Hancock jig for handling low-grade ores, and contains illustrations of several large plants equipped with them. No. 1607 is an explanation of the company's horizontal double-acting crank-and-flywheel high-duty plunger pumps driven by cross-compound Reynolds-Corliss engines. Catalogue 123 is a description of many types of saw-mill carriages and accessory machinery.

The General Pneumatic Tool Co., Montour Falls, N. Y., describes in its bulletin 56 the electric hoist it has brought out for the same kind of service as its well-known pneumatic hoist, with which it is practically identical in general design. It is made in seven sizes of 1,000 to 20,000 lb. capacity, and with or without trolleys for operation on overhead I-beam tracks. The bulletin also illustrates an electric hoist for use on jib cranes and derricks.

The St. Mary's Sewer Pipe Co., St. Mary's, Pa., has issued a small pamphlet giving priced tables of standard double-strength and special sewer pipe up to 36 in. in size, branches, specials, clay stove pipe, flue linings and similar clay products.

A profusely illustrated description of a 5,600-h.p. hydraulic power development near Lowell, Kan., is given in a pamphlet from the Arnold Co., Marquette Bldg., Chicago.

A novel hoisting drum has been put on the market by the Hayward Co., 97-103 Cedar St., New York, to enable a single-drum engine to operate a two-chain automatic bucket, or to enable a double-drum engine to operate a two-chain bucket and raise or lower a boom at the same time. This novel device is described in a booklet which the company has just issued.

A series of picture postal cards has been printed for the Friestedt Interlocking Channel Bar Co., Tribune Bldg., Chicago, bearing excellent illustrations of important works in which its steel sheet piling has been used.

A catalogue of belt-driven alternating-current generators of 32 to 700-kw. capacity has been issued by the National Electric Co., Milwaukee. These have been recently designed for use in industrial plants where induction motors, arc lamps and other devices tending to introduce inductive conditions into an alternating-current system make it necessary to employ generators with good regulation, furnishing normal voltage at all power factors incident to such conditions. The construction of the apparatus is fully described, and the tables of dimensions are unusually complete.

Large variety of boilers are described in full detail in an unusually handsome catalogue published by The Bigelow Co., 2 Lloyd St., New Haven, Conn. The construction of horizontal return tubular, locomotive, upright tubular, Manning and internally fired types is explained at length, and a large amount of information concerning settings and other features of boiler practice are given.

Most people believe that whatever painting of structures is to be done should be carried out in the spring of the year. For those who hold this opinion folder B4r, issued by the Joseph Dixon Crucible Co., Jersey City, N. J., will prove of much interest, for it is a brief talk on the advantages of fall painting for steel-work, metal and wood.

Contractors and engineers interested in concrete work will find considerable interesting information in booklets 2R and 3R prepared by the Ransome Concrete Machinery Co., 11 Broadway, New York. Booklet 2R describes the company's batch mixer, which contains eight steel scoops riveted to the inside of the drum for the purpose of picking up and turning over the materials in the same way that men turn them over in hand mixing. The scoops are shaped so as to give the materials a reciprocating motion within the drum and thus shorten the time required to mix them thoroughly. Booklet 3R describes a new form of concrete cart designed to facilitate the delivery of the material from the mixer to the work. The makers claim that with it one man can handle about three times as much concrete as with a wheelbarrow.

The Sturtevant Mill Co., 111 Clayton St., Boston, Mass., has been working for some time on a new gyratory rock and ore crusher, which is described in its catalogue 14. This crusher has been designed specially for delivering a finer product, if desired, than is usually obtained with such machines, and reduces the rock to $\frac{1}{4}$ in. or finer without the use of screens. A feature of its design which is also unusual is the arrangement of the casing in the form of leaves which can be swung open like the doors of a safe, leaving all the interior parts accessible. These machines are made in various sizes with capacities of 2 to 25 tons per hour.

The modern cement testing laboratory has reached a position of such importance that considerable special apparatus designed particularly for it can now be furnished commercially. The testing machines for breaking briquettes and the screens for determining the fineness of grinding are no longer sufficient for a thoroughly equipped laboratory, as is evident from the long list of apparatus handled by Eimer & Amend, 205-211 Third Ave., New York City.

In handling concrete with a derrick it is often somewhat troublesome to dump the batches just where they are wanted without spending considerable time in adjusting the bucket so it will discharge properly when turned over. To avoid these delays, which amount to considerable time in many situations, the G. L. Steubner Iron Works, Vernon Ave., Long Island City, N. Y., has recently designed a bottom dumping bucket which is described in its catalogue 553. This book also contains information about narrow gauge cars, portable track, blocks and other supplies for contractors' purposes.

Probably every contractor and manager of an industrial plant spends considerable money annually for wrenches, and sometimes the bill for these tools runs up to a large amount. The Trimont Mfg. Co., 9-39 Amory Ave., Roxbury, Mass., has lately issued a new catalogue, No. 11, containing a description of an unusual variety of wrenches, including a number of novelties designed particularly for pipe fitters, which received a gold medal at the Louisiana Purchase Exposition.

The tough hardpan of New England is a material which tries the construction of a steam shovel as much as anything that is to be found. The Boston shovel built by John Souther & Co., P. O. Box 3118, Boston, Mass., has been used for many years on this hardpan, and the construction developed as the result of this long experience is described in the company's catalogue. Of course these machines will work as well in sand, gravel and clay, one of them having made a record of 1,000,000 cu. yd. in clay in two years.

One of the interesting novelties to be seen on the Pittsburgh filtration works, now under construction, is a system of collapsible steel centering for the great number of conduits and channels on this great undertaking. These centers can be set up and taken down by common labor, and when removed leave an absolutely smooth surface. One set of them is sufficient for any length of sewer or conduit, without renewal. A catalogue describing their construction and use can be obtained from the Blaw Collapsible Steel Centering Co., 1414 Penn Ave., Pittsburgh, Pa.

Expanded metal lath has become so well established as a material for partitions and for reinforcing concrete that it cannot be considered a novelty. Nevertheless the collection of suggestions for its use recently prepared by Dept. B of the Bostwick Steel Lath Co., 472 Brown St., Niles, Ohio, will prove of value to engineers and architects, particularly as the company makes two types of lath, for partitions and reinforcement respectively.

Catalogue 3V issued by the Burnham-Hitchings-Pierson Co., 1133 Broadway, New York, describes sash-lifting apparatus which requires no rods, chains or bars in the center of the shop or other room fitted with it. A system of rods and worm gears can be installed so that one operating wheel on the wall of the room will shift a hundred sash if necessary.

*Items marked thus give the names of parties awarded contracts.

CONTRACTING NEWS

OF SPECIAL INTEREST TO
CONTRACTORS, BUILDERS, ENGINEERS AND
MANUFACTURERS
OF ENGINEERING AND BUILDING SUPPLIES.

WATER.

Notes Arranged Alphabetically by States.

Brighton, Ala.—This town is reported to have completed arrangements with the Bessemer Water Works Co., of Bessemer, for installing water works and a sewerage system at Brighton.

Los Angeles, Cal.—Local press reports state that A. E. Poole, J. H. Braly, and an eastern syndicate have purchased ranch land and water rights along Mojave River and plan to bring to Los Angeles County a steady flow of 7,500 inches of water; the cost of bringing the water to Los Angeles County is estimated at \$6,000,000.

***Los Angeles, Cal.**—The U. S. Cast Iron Pipe & Fdy. Co., represented by the Crane Co. of Los Angeles, secured the contract for furnishing pipe (bids opened Oct. 16) at \$35 per ton for 16, 18, 20, 24 and 30-in. pipe; \$36 per ton for 6, 8, 10 and 12-in. pipe, and \$37 per ton for 4-in. pipe, f. o. b. cars Los Angeles.

Woodland, Cal.—It is stated that bids will be received until Nov. 20 by Chas. W. Pickard, City Clk., for furnishing material and erecting a 120,000-gal. tank and tower, 64 ft. high.

Brighton, Colo.—The citizens are reported to have voted to purchase the water works of the Brighton Water & Electric Light Co., and the city will enlarge the plant and extend the mains.

Columbus, Ga.—At a recent meeting of the Bd. of Water Works Comrs. a resolution was adopted inviting proposals from those who have any propositions to make as to supplying a water works system, or any part thereof, to the city of Columbus. These proposals are to be submitted in writing by Nov. 22. Engineer, J. L. Ludlow, Winston-Salem, N. C.

Ashburn, Ga.—See "Power Plants, Gas and Electricity."

Franklin, Idaho.—The citizens are reported to have voted to issue \$7,500 water works bonds.

Boise, Idaho.—The Boise Artesian Hot & Cold Water Co. is reported to be considering the matter of increasing the capacity of its plant by sinking new well and chambers at a cost of \$15,000.

Montpelier, Idaho.—Chas. E. Harris, City Clk., writes that it was voted Oct. 30 to issue \$22,500 bonds for the construction of water works. Engineer, Edw. Beucher.

Chicago, Ill.—The City Council is reported to have authorized J. M. Patterson, Comr. of Pub. Wks., to confer with the South Park Comrs. for the construction of an independent water plant to supply the parks and boulevards on the south side.

Chicago, Ill.—W. A. Shaw, the new City Engr., is reported to have commenced work on plans for the immediate extension and rehabilitation of the water system. Among the reforms which he will be directed to bring about are the installation of water meters and the establishment of an independent water system for the stock yards.

Bids will be received until Nov. 21 by the Dept. Pub. Wks. (Jos. M. Patterson, Comr.) for furnishing and delivering at the water works shops, Ashland Ave., near 22d St., water meters of the disk type, of the following sizes and approximate quantities: 100 $\frac{1}{4}$ -in.; 500 $\frac{3}{4}$ -in.; 200 1-in.; 40 $1\frac{1}{4}$ -in.; 100 $1\frac{1}{2}$ -in.; 100 2-in.; 80 3-in.; 20 4-in., and 12 6-in. meters.

Downers Grove, Ill.—It is stated that bids will be received until Nov. 15 by the Bd. Local Improve. (Chas. Mochel, Pres.) for furnishing material and laying the following approximate quantity of c. i. water pipe, hydrants and valves: 2,616 ft. 8-in., 3,264 ft. 6-in. and 1,400 ft. 4-in. pipe; 9 hydrants and 18 valves with boxes.

***Lanesville, Ind.**—Frank Schefold, of New Albany, is reported to have secured the contract for constructing water works for \$6,000.

Davis, Ind. Ter.—The citizens voted Oct. 27 to issue \$25,000 bonds for the construction of water works.

It is reported that bids will be received until Nov. 29 by Mayor J. R. Clemons, for constructing the proposed water works.

Hammond, La.—Bids will be received until Dec. 6 (readvertisement) by the Mayor and Bd. Aldermen for constructing water works. C. H. Jenks, Engr., Fayette, Miss.

Hamilton (Baltimore), Md.—See "Power Plants, Gas and Electricity."

Springfield, Mass.—The Water Comrs. are reported to have authorized Allen Hazen, of New York, N. Y., to prepare plans and estimate of cost of an intermittent filtration plant.

Brockton, Mass.—Chas. R. Felton, City Engr., has been asked to prepare a report on the advisability of installing high-pressure water service for fire protection.

Pittsfield, Mass.—The Bd. of Aldermen is reported to have referred to the Finance Com. the petition of residents of West Pittsfield, that provision be made for a water supply in that section of the city. It is planned to use water in the Smith and May Brooks and build a reservoir.

Iron River, Mich.—See "Power Plants, Gas and Electricity."

Duluth, Minn.—The Water Bd. is reported to be considering the purchase of a 10,000,000 gal. pump for the Lakewood pumping station.

Jackson, Miss.—The City Council is reported to be considering the question of constructing municipal water works.

Savannah, Mo.—The citizens are reported to have voted Oct. 31 to issue \$35,000 bonds for the construction of water works.

Neosho, Mo.—W. E. Smith, City Clk., writes that at the election, Oct. 24, the citizens voted against issuing \$40,000 bonds for water works.

St. Louis, Mo.—The Bd. of Pub. Improv. is reported to have on Nov. 3 awarded the contract for the construction of two basins at the Chain of Rocks to Fruin & Colnon, Laclede Bldg., for \$464,523.

Hamilton, Mont.—The Blodgett Creek Reservoir Co., formed for the purpose of preserving the waters of Blodgett Creek, are reported to be making plans to build extensive dams below Camp Comfort.

Perth Amboy, N. J.—Bids will be received by the Bd. of Water Comrs. until Nov. 15 for furnishing one tubular boiler and fittings, to be delivered at Runyon; also same date for furnishing material and construction complete one 25-ft. suction well at Runyon, both advertised in The Engineering Record.

Asbury Park, N. J.—The West Allenhurst Water Co., of Asbury Park, is reported incorporated with a capital of \$30,000. Incorporators: J. Edw. Wortman, Asbury Park; Geo. Allen, of Allenhurst, and others.

Rochester, N. Y.—H. B. Hooker & Son, Wilder Bldg., are reported to have secured the contract for laying a 36-in. water main to connect Hemlock Lake conduit and Cobbs Hill reservoir, for \$9,155.

South Brooklyn, O.—Bids will be received until Nov. 27 at the office of W. T. Pupikofer, Village Clk., for \$7,270 water main improvement bonds.

Cleveland Heights, O.—The Water Works Constr. Co., of Cleveland, has secured contracts for laying water mains on Coventry, Cedar, Lee and Noble Roads and Superior St., at a total cost of \$51,437.

Cincinnati, O.—J. R. Ware & Sons, of Cincinnati, have secured the contract for furnishing sand and gravel for the new filtration system, for about \$9,120 (bids opened by Bd. of Truss, Comrs. of Water Wks., Oct. 13).

Hood River, Ore.—J. H. Shoemaker, Secy. Bd. Dirs. Hood River Irrig. Dist., writes that the following are the bids opened on Oct. 28 for canal work, etc.: (a) Glebisch & Joplin, 1 E. 30th St., Portland (awarded contract); (b) Meares Bros., Hood River; (c) Robt. L. Hamil Co., Seattle, Wash.:

	a	b	c
10,000 cu. yds. solid rock.....	\$1.00	\$1.75	\$1.50
20,000 cu. yds. loose rock.....	.40	.86	.60
50,000 cu. yds. earth work.....	.20	.21	.30

North Yamhill, Ore.—It is reported that \$10,000 has been subscribed toward the construction of water works.

Eugene, Ore.—See "Power Plants, Gas and Electricity."

Philadelphia, Pa.—The following are reported to be the bids opened on Nov. 3 by A. Lincoln Acker, Dir. Dept. Pub. Wks., for the installation of 10 additional boilers to increase the capacity of Belmont pumping station: E. Keeler Co., Inc., \$51,000 (time, 8 mos.); I. P. Morris Co., \$43,000 (3½ mos.); Coatesville Boiler Wks., \$39,800 (8 mos.); Harlan & Hollingsworth Co., \$46,550 (6 mos.).

Providence, R. I.—Bids will be received by the Dept. of Pub. Wks. until Nov. 16 for furnishing and delivering at the city yard a quantity of c-i. water pipe, as advertised in The Engineering Record.

Belle Fourche, S. D.—Orman & Crook, of Pueblo, Colo., are reported to have secured the contract for the construction of an earthen dam and appurtenances and 17½ miles of canals, 12 miles from Belle Fourche, bids opened Oct. 26. For detail list of bids received for the work, see issue of The Engineering Record Nov. 4.

Chattanooga, Tenn.—See "Power Plants, Gas and Electricity."

Lawrenceburg, Tenn.—See "Power Plants, Gas and Electricity."

Sherman, Tex.—The citizens are reported to have voted to issue \$10,000 bonds for water works extension, and \$20,000 for street paving purposes.

Ft. Worth, Tex.—The Laidlaw-Dunn-Gordon Co., of Cincinnati, O., is stated to have secured the contract for the steam plants to drive the air compressors at the water works (bids opened Oct. 14) for \$35,464.

Franklin, Va.—Chas. S. York, 1526 E. Biddle St., Baltimore, Md., is stated to have been selected as engineer to superintend the construction of water works, to cost about \$40,000.

Suffolk, Va.—It is reported that the question of issuing \$40,000 water and sewer bonds is under consideration.

Casper, Wyo.—County Surveyor Bradley is reported to have located a new reservoir for ranchmen at Two Bar ranch on Bates Creek.

SEWERAGE AND SEWAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Brighton, Ala.—See "Water."

Douglas, Ariz.—The question of constructing a sewerage system here is reported under consideration.

San Jose, Cal.—City Engr. Chas. H. Pieper has completed and presented to the Mayor and Council his report on the sewerage system, in which he estimates the cost of improving the system at \$121,000, with \$54,000 extra for the renewal of the extreme lower portion of the outfall sewer (which is now of wood) for a length of 9,977 ft., with more permanent material.

Roy E. Walter, City Clk., writes that an election will soon be held to vote on issuing about \$300,000 bonds to be used for new sewers, schools, park work and for the Fire Dept.

Fresno, Cal.—The citizens are reported to have voted Oct. 31 to issue \$175,000 bonds for the improvement of the sewerage system. The plans are said to call for an entire new set of mains and an outfall with septic tank and sewer farm combined.

Downers Grove, Ill.—Bids will be received until Nov. 15 by the Bd. Local Improv. (Chas. Mochel, Pres.) for furnishing material and constructing the following approximate quantities of storm water drains, with manholes and inlets: 5,740 ft. open ditch improved; 870 ft. 20-in. tile drain; 18-in., 1,455 ft. 15-in. and 2,720 ft. 12-in. tile drain; 14 manholes and 24 street inlets.

Chicago, Ill.—Bids will be received until Nov. 23 by the Dept. Pub. Wks. (Jos. M. Patterson, Comr.) for constructing and erecting sluice gates and machinery at the Lawrence Ave. pumping station.

Alton, Ill.—We are informed that the City Council on Oct. 28 passed ordinances providing for the construction of 8 miles of pipe sewers. Edmond Beall, Mayor. E. E. Rutledge, City Engr.

South Bend, Ind.—Plans and specifications have been adopted for a trunk sewer in Kenwood Ave., to be either of brick or concrete, 66-in. internal diameter, 2,400 ft. long. A. J. Hammond, City Engr.

Rockport, Ind.—The Town Clk. writes that bids will probably be called for in Dec. for a sewerage system, to cost about \$4,000.

Indianapolis, Ind.—Bids will be received by the Bd. Pub. Wks. (M. A. Downing, Pres.) until Nov. 15, for constructing a main sewer in the alleys east and west of Rural St.

Clinton, Ia.—The Peoples Constr. Co., of Davenport, is reported to have secured the contract for constructing sewers at Clinton (bids opened Oct. 25) for \$168,725.

Vinton, Ia.—Engineer M. Tschirig, of Davenport, is reported to have prepared plans for a sewerage system, which he estimates will cost about \$70,000.

Des Moines, Ia.—Bids will be received until Nov. 16 by the Bd. Pub. Wks. (W. W. Wise, Chmn.) for constructing 2,680 lin. ft. 15-in. vitr. clay pipe sewer in W. 9th St.

Shreveport, La.—Bids will be received by the Shreveport Water Co., until Nov. 24, for constructing about 12,000 ft. of 8 to 10-in. vitrified pipe and c. i. sewers, cuts varying from 6 to 30 ft., as advertised in The Engineering Record.

Baltimore, Md.—Calvin Wheeler Hendrick, of New York, N. Y., has been selected as chief construction engineer for the proposed new sewerage system.

Marion, Mass.—The citizens are reported to have voted Oct. 30 to appropriate \$20,000 for the construction of sewerage system. Chas. H. Delano, Town Clk.

Grand Rapids, Mich.—This city proposes expending the coming season about \$300,000 for large sewers and paving. Contracts will be let during the winter. L. W. Anderson, City Engr.

Coldwater, Mich.—The Bd. of Pub. Wks. is reported to have decided to construct a sewer in Dist. 7.

Gulfport, Miss.—Bids will be received until Nov. 22 by P. F. Martin, City Clk., for constructing Section "A" of the sewerage system, consisting of approximately 1 mile of 16-in. outfall and a 1½ of terra cotta piping and the necessary manholes, etc., as advertised in The Engineering Record.

Louisiana, Mo.—The citizens are reported to have voted on Oct. 31 in favor of extending the franchise of the Louisiana Water Co., which carries with it a franchise for a sewerage system. It is stated that work on constructing the sewerage system will begin at once.

Kansas City, Mo.—The Public Improvement Committee and E. A. Harper, City Engr., will on Nov. 15, receive bids for the following sewer work: Goose Neck storm sewer to consist of 8,000 ft. of from 3 ft. to 10 ft. brick sewer; probable cost, \$66,000; Harrison Boule. sewer, to cost about \$12,000, and to consist of 1,400 ft. 4-ft. 2-in. brick sewer; 1,300 ft. 18-in. pipe and 300 ft. 24-in. pipe; and Gillham Road storm sewer, to cost about \$110,000, and to consist of 7,700 ft. of from 3-ft. 8-in. to 9-ft. brick sewer and 700 ft. reinforced concrete sewer.

Merchandiseville, N. J.—D. Everett Hill, of the City Waste Disposal Co., 156 5th Ave., New York, N. Y., has been selected as Consulting and Designing Engr. for the proposed sewerage system. After surveys and estimates are prepared, an election to issue bonds will be held. A. W. MacCallum, Chmn. Sewer Com., 135 N. Center St.

Milford, N. Y.—F. E. Teel, Village Clk., writes that an election will be held Nov. 14 to vote on the construction of a sewerage system.

Brooklyn, N. Y.—Bids will be received until Nov. 22 by Martin W. Littleton, Boro. Pres., for furnishing material and constructing sewers in portions of several streets. Engineer's estimate: 945 lin. ft. 18-in.; 2,959 lin. ft. 15-in.; and 4,666 lin. ft. 12-in. pipe sewer; 44,200 ft. B. M. found. plank; 160,000 ft. B. M. sheeting and bracing; 684 cu. yds. concrete cradle; 85 manholes and 14 sewer basins.

Lexington, N. C.—See "Water."

Lenoir, N. C.—Bonds to the amount of \$40,000 are reported to have been authorized for sewer purposes.

*Items marked thus give the names of parties awarded contracts.

Adams, N. D.—The question of constructing a sewerage system is reported under consideration here by the town, to cost about \$5,500. The Soo R. R. Co. is reported to have decided to pay \$3,500 toward the construction.

Urbana, O.—The Bd. of Pub. Service is reported to have approved the plans and specifications as prepared by Young, Fardwell, Hook & Co., of St. Louis, Mo., for the proposed sewerage system.

Ravenna, O.—It is stated that the engineering work preliminary to the construction of sewers here has been commenced. Actual construction work will probably be started in the spring.

Elmwood Place, O.—Bids will be received until Nov. 15 by H. G. Schaefer, Village Clk., at the office of Scott Bonham, 519 Main St., Cincinnati, for \$2,500 bonds for constructing sewers in McGregor Ave. and Center Hill St.

Akron, O.—Bids will be received until Nov. 27 at the office of Wm. A. Durand, City Aud., for \$23,000 bonds, issued for the purpose of paying the city's part of the cost of constructing a certain main sewer.

South Brooklyn, O.—Bids will be received until Nov. 27 at the office of W. T. Pupikofer, Village Clk., for \$3,480 sewer improvement bonds.

Columbus, O.—The lowest bid opened on Nov. 2 by the Bd. of Pub. Service for the sewage disposal plant is reported to have been submitted by Sullivan, Murphy & Miles, of Columbus, for \$432,134.

Cleveland Heights, O.—The Water Works Constr. Co., of Cleveland, has secured the contract for constructing sewers on Coventry Road, Superior St., Monroe and Hurst Aves. and Euclid Heights Boule., at a total cost of \$27,079.

Norwalk, O.—T. P. Kellogg, Clk. Bd. Pub. Service, writes that bids for preparing plans for the sewerage system and sewage disposal plant will be received until Nov. 13.

Cincinnati, O.—Plans and estimates for the proposed Millcreek sewer are reported to have been finally completed, under the direction of City Engr. J. Edw. Breen; the cost of the first 6½ miles of the sewer, including right of way, is reported to be about \$900,000.

Grants Pass, Ore.—The following are reported to be the bids opened on Oct. 26 by City Council for constructing sewers in 2d and 7th Sts.: F. A. Erickson, Tacoma, Wash., \$18,500; O. R. Swearingen and C. A. Dickinson, of Grants Pass, \$18,500; E. M. Moore, Tacoma, Wash., \$16,800; Herbert & Scott, Portland, \$18,731; Bechill Bros., Portland, \$17,946; J. L. Calvert, of Grants Pass, \$17,666; G. W. Kearns, Grants Pass, \$16,720; Simon Kloverdahl, of Eugene, \$15,512; J. B. Slemmons, Portland, bid for 2d St. sewer, \$12,186, and for 7th St., \$8,132.

Philadelphia, Pa.—Bids will be received until Nov. 24 by the Dept. Pub. Wks. (A. Lincoln Acker, Dir.) for constructing branch sewers.

Suffolk, Va.—See "Water."

Harrington, Wash.—The City Council is reported to have accepted the plans of P. F. Byrnes, of Spokane, for a sewerage system.

Milwaukee, Wis.—The Bd. of Pub. Wks. is reported to have on Nov. 1 awarded the contract for building section No. 4 of the relief sewer for 30th St. sewer tunnel to Chas. Forrestal, at \$6.32 per ft.; total cost, \$20,192.

St. Boniface, Man.—The Town Council has decided to construct the following sewers: On Meuron and Dubus Sts., to cost \$18,777; St. Marys Road, cost \$17,655; Kitson St. and Tache Ave., \$7,164. Theo. Bertrand, Secy.-Treas.

Halifax, N. S.—F. H. W. Doane, City Engr., writes that it is proposed to construct about 4 miles of concrete block sewers from 12 x 18 in. to 52 in., to cost about \$150,000 to be constructed by day work.

Hamilton, Ont.—E. G. Barrow, City Engr., writes that the proposed sewerage system in the manufacturing district, will probably be constructed in the spring, at a cost of \$37,000.

Ft. Frances, Ont.—The Council is reported to have accepted the plans of John Galt, of Toronto, for a sewerage system.

Toronto, Ont.—The Cameron Septic Tank Co., 812-813 Monadnock Blk., Chicago, Ill., has just closed contract with the City of Toronto for septic tanks and contact beds for the district east of Woodbine Ave. The same company has also secured a contract from the Muskoka Lakes Navigation & Hotel Co. for septic tanks and contact beds for the Royal Muskoka Hotel, on Lake Rosseau.

Hintonburg, Ont.—W. A. Mason, City Clk., writes that a special committee is investigating the question of constructing a sewerage system.

BRIDGES.

Notes Arranged Alphabetically by States.

Durango, Colo.—Thos. G. Edwards is stated to have received the contract for constructing a stone bridge at Durango, for \$24,000.

Willimantic, Conn.—The contract for constructing a bridge in Willimantic is reported to have been awarded as follows: Owego Bridge Co., of Owego, N. Y., for steel work, \$9,900; Chas. Larrabee, Jr., for stone work, \$2,100.

Chicago, Ill.—The City Council is reported to have transferred \$40,000 from the funds of the Comr. of Pub. Wks. to the Engineering Bureau, in order that certain bridges may be repaired.

Waukegan, Ill.—H. Thacker, City Clk., writes that the question of constructing a new bridge to replace the present structure at S. Genesee St., is under consideration; cost about \$90,000.

Urbana, Ill.—It is stated that bids will be received until Nov. 15 by the Bd. Co. Comrs., for constructing a substructure and superstructure of 140 ft. highway bridge on concrete. Ira O. Barker, Engr., Champaign, Ill.

Stearns, Ky.—See "Railroads."

Hyde Park, Mass.—See "Railroads."

Springfield, Mass.—Bids will be received until Nov. 15 by the Bd. Co. Comrs. (Robt. O. Morris, Clk.) for furnishing material and laying a wooden floor system upon the bridge over the Connecticut River, between Chicopee and West Springfield, consisting of hard pine wooden stringers and 2-in. hard pine planking for the sidewalk, and for the roadway a floor according to either one of the designs. Geo. F. Swain, Engr., Boston.

Cambridge, Mass.—The following are the bids opened Nov. 1 for furnishing and placing filling and ballast at the approach to the Brookline St. Bridge, Cambridge: Wm. H. Ellis, \$19,330; Wm. L. Miller, \$17,930; T. H. Gill & Co., \$15,520, and Wm. B. Mullen, 95 Milk St., Boston, \$10,078.

Boston, Mass.—The following are the bids opened on Nov. 2 by Wm. Jackson, City Engr., for constructing the superstructure of a bridge at Brookline St., bet. Boston and Cambridge: H. P. Converse & Co., 120 Milk St., Boston, \$15,400 (awarded contract); New England Structural Co., Boston, \$16,154; Pennsylvania Steel Co., Steelton, Pa., \$16,400; Boston Bridge Works, Inc., Boston, \$16,580; Frederick W. Page, Powers Bldg., Rochester, N. Y., \$17,149; Eastern Bridge & Structural Co., Worcester, \$17,242; Berlin Constr. Co., Boston, \$17,453; American Bridge Co., of New York and Boston, \$17,500; The Canton Bridge Co., 147 Milk St., Boston, \$17,550; New Jersey Bridge Co., New York, N. Y., \$17,603; Croton Bridge Co., Worcester, \$17,990, and Oswego Bridge Co., Oswego, N. Y., \$18,250.

Garden City, Minn.—Bids will be received until Nov. 17 by the Bd. of Superv. for furnishing material and constructing a steel bridge across Watonwan River near Garden City. G. W. John, Town Clk.

Minneapolis, Minn.—Bids are wanted Nov. 24 for the steel work necessary for widening Washington Ave. Bridge; probable cost, \$75,000. Address Andrew Rinker, City Engr.

St. Charles, Mo.—It is stated that bids are wanted until Nov. 21 for repairing and raising one 130-ft. span, and one 90-ft. span iron bridges, that were torn from their stone abutments during recent heavy rains. Alfred Riske, Co. Bridge Comr.

Perth Amboy, N. J.—Sanford & Harris are stated to have secured the contract for constructing the approach to the Amboy Bridge for \$4,465. Bids opened by the Bd. of Chosen Freeholders of Middlesex County at New Brunswick.

New York, N. Y.—Ordinances have been adopted providing for the issue of \$250,000 corporate stock for completing construction of Pelham Bridge over Eastchester Bay in Boro. of Bronx, also \$500,000 corporate stock for constructing and improving Manhattan terminal of the Williamsburg Bridge.

Wm. A. Pratt, Ch. Engr., New York & Westchester R. R. Co., writes that the company expects to be ready about Nov. 15 to receive bids for constructing the proposed 8 bridges along its line.

Reading, Pa.—Bids are wanted until Nov. 15 for constructing county bridges. H. F. Livingood, Co. Compt.

Spokane, Wash.—The Bd. Pub. Wks. is stated to have awarded the contract (bids opened Oct. 19) for constructing a bridge over Spokane River at Mission Ave. to carry the new water main, to the American Bridge Co., Crocker Bldg., San Francisco, Cal., for \$10,247.

Tacoma, Wash.—It is stated that bids will be received until Nov. 24 by the Bd. Co. Comrs., for piling and trestling a portion of Lincoln Ave., and erecting a drawbridge across Hylebos Creek, near Tacoma.

Toronto, Ont.—City Engineer Rust, in his report to the Bd. of Control, is reported to have recommended the construction of a swing or rolling lift bridge over Western Gap at Bathurst St., at a cost of \$200,000. If it should be considered an impediment to navigation he would recommend the construction of 2 aerial bridges costing \$220,000.

PAVING AND ROADMAKING.

Notes Arranged Alphabetically by States.

Montgomery, Ala.—Bids will be received until Nov. 20 by R. S. Williams, City Treas., for paving with Schillinger or hexagon block the sidewalks on portions of several streets.

Centralia, Ill.—The following are the bids opened Oct. 31 by the Bd. of Local Improv. for brick paving. (Engineers, the Iowa Eng. Co., Clinton, Ia.): (a) Fruin & Franks, Jacksonville, Ill.; (c) Case & Evans, Bloomington, Ill.; Goshen, Ind. (Figure given per sq. yd. on Albion, Ill., block; he also bid on various other kinds of block adding to the cost per sq. yd.):

	a	b	c	d
33,688 cu. yds. excav.....	\$0.47½	\$0.25	\$0.30	\$0.27
766 cu. yds. fill.....	.47½	.10	.10	.10
50,139 lin. ft. curb 4 x 20 in.....	.42	.55	.45	.46
5,170 BM. ft. white oak headers, 3 x 8 in.....	30.00	10.00	20.00	.02½
2,549 lin. ft. stone headers.....	.50	.35	.40	.45
94,631 sq. yds. paving block.....	1.60	1.56	1.49	1.56
Totals	\$190,263	\$184,873	\$174,869	\$181,137

East St. Louis, Ill.—Bids will be received by the Bd. of Local Improv. until Nov. 15 for improving St. Clair Ave. from 1st St. to the Terminal R. R.

Indianapolis, Ind.—The Bd. of Works is stated to have adopted a resolution providing for the paving with asphalt a portion of 16th St.

Crownpoint, Ind.—W. L. Allman, Co. Aud., writes that W. W. Hatch & Sons, of Goshen, have secured the contract for 11 miles of gravel road in Hobart Township (bids opened Nov. 6) for \$57,230.

Evansville, Ind.—The Bd. of Public Wks. is stated to have passed resolutions providing for the grading, curbing and paving with brick Locust, Water and Walnut Sts., also paving with asphalt on Riverside Ave.

Chatham, Mass.—John H. Drumm, of Harwich, is stated to have secured the contract for constructing a section of highway (bids opened Nov. 2) for \$5,027.

Lansing, Mich.—H. A. Collar, City Engr., will prepare plans for paving Franklin Ave. W. from Pine St. to Washington Ave., about 2,079 ft.

Grand Rapids, Mich.—See "Sewerage and Sewage Disposal."

St. Paul, Minn.—The contract for macadamizing a portion of Maria Ave. (bids opened Nov. 2) has been awarded to J. M. Thornton, 323 Gilfillan Bldg., for \$5,843.

Kirksville, Mo.—Stephen Hall, City Engr., writes that the following are the bids opened on Nov. 6 by the Mayor and Council for paving with brick on Portland cement concrete foundation: (a) Chas. L. Besler, Cedar Rapids, Ia., \$20,168; (b) Rackliffe & Gibson, St. Joseph, \$19,124; (c) M. Ford, Cedar Rapids, Ia., \$18,626, and (d) C. E. Hall, Clinton, \$17,771 (awarded contract).

	a	b	c	d
8,550 yds. brick paving.....	\$2.23	\$2.08	\$2.04	\$1.95
2,116 lin. ft. curb.....	.45	.55	.47	.46
703 lin. ft. 8-in. sewer pipe.....	.20	.25	.27	.21

Kansas City, Mo.—The contract for paving a portion of Main St. is reported to have been awarded to the Cleveland Asphalt Co., at \$1.89 per sq. yd.

Joplin, Mo.—E. J. Overly, of Joplin, is stated to have received the contract for paving with vitrified brick the alley between Main and Joplin Sts., between 1st and 10th Sts., for \$12,919.

Trenton, N. J.—Bonds amounting to \$60,000 for repaving in Trenton are reported sold.

Bayonne, N. J.—Bids will be received by the City Council until Nov. 21 for the construction of about 27,700 sq. yds. asphalt paving, with the necessary curb, etc., as advertised in The Engineering Record.

Jersey City, N. J.—Bids will be received by the Bd. Street and Water Comrs. (Geo. C. Bouton, Clk.), for improving a portion of 16th St. Approximate estimate of quantities: 2,460 sq. yds. Belgian pavt.; 40 lin. ft. curb; 540 sq. yds. repaving; 1,650 lin. ft. redressed and reset curb; 585 cu. yds. sand filling, etc.

Buffalo, N. Y.—The lowest bids received Oct. 27 for paving with asphalt portions of Montgomery and James Sts. is stated to have been submitted by the Barber Asphalt Paving Co., 880 Ellicott Sq., bidding \$7,456 for the latter and \$6,060 for the former.

Kent, O.—Bids will be received until Nov. 20 at the office of Fred Bechtie, Clk., for \$22,000 W. Main St. improvement bonds.

Perrysburg, O.—It is reported that bids will be received until Nov. 20 by T. M. Franney, Village Clk., for \$6,750 bonds, for grading, draining, and curbing Front St.

Cleveland, O.—The contract for paving with brick a portion of Superior St. is stated to have been awarded to Cleveland Trinidad Paving Co., Rose Bldg., for \$12,000.

Springfield, O.—John E. Bretz has secured the contract for paving 1st, 2d and Laurel Sts., about 12,400 sq. yds. at \$1.47 per sq. yd. and 8,300 lin. ft. curb, 53 cts. per lin. ft.

Cincinnati, O.—The Barber Asphalt Co., Traction Bldg., has secured the contract for paving Wade St. with asphalt, 12,500 sq. yds. at \$1.12½ per sq. yd.; total cost, \$31,600.

Bids will be received until Dec. 1 by the Bd. Pub. Service (Geo. F. Holmes, Clk.), for furnishing material and constructing a concrete retaining wall on Russell St., north of E. Court, and improving said street.

Bids will be received until Dec. 8 by the Bd. Co. Comrs., for improving 1,600 ft. Grove Ave., Springfield Township. C. C. Richardson, Co. Aud.

Phoenixville, Pa.—The contract for constructing a State road from Phoenixville to Valley Forge is stated to have been awarded to Dawson & Davis, of Wayne, for about \$26,000.

North Braddock, Pa.—The contract for paving Sedon Ave. with brick (bids opened Nov. 2) has been awarded to Sawders Paving & Constr. Co., of Pittsburgh, for \$5,407. C. A. Stewart, Boro. Engr., Braddock.

31 by the Bd. of Local Improv. for brick paving. (Engineers, the Iowa Eng. Co., Clinton, Ia.): (a) Fruin & Franks, Jacksonville, Ill.; (c) Case & Evans, Bloomington, Ill.; Goshen, Ind. (Figure given per sq. yd. on Albion, Ill., block; he also bid on various other kinds of block adding to the cost per sq. yd.):

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766 cu. yds. fill.....	.47½	.10	.10	.10
50,139 lin. ft. curb 4 x 20 in.....	.42	.55	.45	.46
5,170 BM. ft. white oak headers, 3 x 8 in.....	30.00	10.00	20.00	.02½
2,549 lin. ft. stone headers.....	.50	.35	.40	.45
94,631 sq. yds. paving block.....	1.60	1.56	1.49	1.56
Totals	\$190,263	\$184,873	\$174,869	\$181,137

Doylestown, Pa.—Contracts are stated to have been awarded for constructing the following telford roads (bids received by the State Highway Dept.): Cunningham & Murray, German American Bldg., Philadelphia, one mile in Warrington, for \$6,812; Frazer Constr. Co., 1½ miles in Warminster for \$38,655, and 5 miles in Falls for \$35,912.

*Items marked thus give the names of parties awarded contracts.

Altoona, Pa.—The following are the bids opened on Oct. 25 by the Bd. of Pub. Wks. for 10,057 sq. yds. vitr. clay block paving: Guise Brick & Stone Co., Williamsport, \$18,605 (awarded contract); W. G. Stall's Sons, Couch Bldg., Altoona, \$22,151; Saupp & Drhew, Schenck Bldg., Altoona, \$22,387, and R. B. Vaughn, 2012 8th Ave., Altoona, \$22,304.

Harrisburg, Pa.—The United States Wood Preserving Co., of Perth Amboy, N. J., is reported to have secured the contract for paving with wood block a portion of Front St. for \$103,815.

*The contract for constructing 5,555 ft. of road and 2,100 ft. of brick paving in Crawford County is reported to have been awarded by the State Highway Dept. at Harrisburg to Fred. Robinson, of Meadville, the former at \$14,136 and the latter at \$15,537.

Bristol, Tenn.—The contract for constructing one mile of pike road on the Bristol-Blountsville thoroughfare is reported to have been awarded to Horace Mann of Knoxville, for \$4,000.

Sherman, Tex.—See "Water."

El Paso, Tex.—It is stated that the contract will soon be let for paving streets in the Downtown Dist., at a probable cost of \$175,000.

Richmond, Va.—The City Engineer is stated to have estimated the cost of widening a portion of Franklin St. at \$25,000.

Spokane, Wash.—Mitchell Bros. are stated to have received the contract for grading, curbing, parking and constructing sidewalks on a portion of Cannon St., for \$4,800.

*The contract for grading, curbing and parking a portion of N. Crescent Ave. is stated to have been awarded to Peter Costello, 118 Mission Ave., for \$3,000.

The Barber Asphalt Paving Co., of Spokane, is stated to have received the contract (bids opened Oct. 28) for paving with asphalt 2d Ave., for \$10,347.

Hamilton, Ont.—The City Council is stated to have adopted the report of the Bd. of Wks., including an appropriation of \$10,000 for the high level road.

POWER PLANTS, GAS AND ELECTRICITY.

Notes Arranged Alphabetically by States.

Lompoc, Cal.—J. M. Stamp is reported to have petitioned Council for a franchise for an electric light plant.

Washington, D. C.—Bids will be received by Jas. Knox Taylor, Superv. Archt., Treas. Dept., Washington, D. C., until Nov. 25 for furnishing and placing the lighting fixtures for the U. S. Bureau of Engraving and Printing (West Building), Washington, D. C., as advertised in The Engineering Record.

Bids will be received until Nov. 21 at the Bureau Supplies and Accounts, Navy Dept., Washington, to furnish at the Navy Yards, Portsmouth, N. H.; Boston, Mass.; New York, N. Y.; League Island, Pa.; Washington, D. C., and Norfolk, Va., a quantity of naval supplies as follows: Schedule 214: Arc lamps, twist drills, etc. Schedule 215: Steel enameled conduit, lighting wire, etc. Schedule 216: Bar steel, nickel steel, forgings, etc. Schedule 218: Motors, armature, incandescent lamps, cable, alphasud, electrical supplies, hydraulic jacks, valve reseating machine, handy billy and pressure pumps, etc. Schedule 219: Galvanized sheet steel, sheet lead, bar iron, pipe fittings, etc. H. T. B. Harris, Paymaster Gen., U. S. N.

Bids will be received until Nov. 16 at the Treasury Dept., Bureau Public Health and Marine Hospital Service, Washington (Walter Wyman, Surg.-Gen.) for installing all the combination gas and electric light fixtures required.

Ashburn, Ga.—The question of constructing water works and an electric light plant is reported under consideration here. Engineer, J. B. McCrary, of Senoia.

Columbus, Ga.—Geo. J. Baldwin, of Savannah, Ga., Pres. Columbus R. R. Co. is reported interested in the construction of a dam at Clapps Factory on the property of the Chattahoochee Falls Co.

Monmouth, Ill.—The Monmouth Gas & Electric Co. is reported to have completed plans for an electric light plant.

Chicago, Ill.—Bids will be received until Nov. 16 by Wm. Carroll, City Electrician, for furnishing the Dept. of Electricity, with steam superheater equipment for 4 water-tube boilers, for the R. A. Waller Municipal Electric Light Station, 64th St. and Wentworth Ave.

***Lockport, Ill.**—The Eng. Com. of the Drainage Bd. at Chicago is reported to have recommended that contracts be awarded as follows for work necessary to transmit power to be generated by the Sanitary Dist. Canal at Lockport and Joliet to Chicago as follows: Switchboards and transformers, the Stanley Elec. & Mfg. Co., \$3,546; they also secured contract for rheostats for generators, \$1,515; Oil circuit breakers and switches, the Arthur Prantzen Co., \$13,836; they also secured the contract for bus bar compartments, for \$8,629. Conduits and wiring connections, the Brennan Electric Constr. Co., \$6,286. Transformers and lighting arresters, the General Electric Co., \$74,888. Aluminum conductors, the Western Elec. Co., \$423 per mile. Erecting aluminum conductors, the Brennan Elec. Constr. Co., \$1,350. High-tension insulators, the Porter & Berg Co., \$5,920, and electric crane, the Whiting Fdry. & Equipment Co., \$5,800.

Chicago, Ill.—The following are the bids opened by the South Park Comrs., Oct. 25, for engines, generators, etc., for the Washington Park power house:

Two cross compound condensing engines (a) for 1,000-kw. generator; (b) for 500-kw. generator; Hoover-Owens-Reuschler Co., a \$22,200, b \$11,500; Filer & Stowel Co., a \$25,000, b \$16,000; Allis-Chalmers Co., a and b total, \$35,425; Harrisburg Fdry. & Machine Co., a \$22,236, b \$12,444; Fulton Iron Wks., a \$21,800, b \$13,600; Shepard Eng. Co., a (2 bids) 125 r.p.m., \$24,500, and 150 r.p.m., \$23,235; b (2 bids) \$14,200 and \$12,600.

Two generators: (a) 1,000 K.V.A. (b) 500 K.V.A.: Stanley-G. I. Electric Mfg. Co., a \$13,155, b \$8,606; Westinghouse Electric & Mfg. Co., a 1,333 K.V.A., \$16,000, 667 K.V.A., \$10,922; Arthur Jones Co., a (2 bids) 120 r.p.m., \$7,084, and 100 r.p.m., \$7,936; b 50 r.p.m., \$4,590, and 100 r.p.m., \$5,560; Allis-Chalmers Co., a and b total \$21,550; Western Electric Co., b \$9,590; General Electric Co., a \$15,081, b \$9,866.75.

Two turbo-alternators (a) 11,000 k.v.a.; (b) 500 k.v.a.: Westinghouse Machine Co., a \$31,000, b \$18,000; Westinghouse Electric Co., a \$30,000, b \$17,000; General Electric Co., a \$34,750, b \$22,790.

One 11-ft. internal diameter, 200-ft. chimney and foundation for same: Mortimer & Tapper, \$27,792 (brick), \$20,874 (steel). Jacob Rodatz (common brick), \$20,542; H. R. Heinicke (radial brick) \$19,383; Weber Steel Concrete Chimney Co. (2 bids) \$14,908 and \$13,928; Alphonse Custodis Chimney Constr. Co., \$27,150, and Thos. F. Pickham, \$19,520.

Geneva, Ind.—W. R. Thurston, of Bern, who recently secured a franchise to construct an electric light plant in Geneva, is stated to have decided to organize a stock company.

Burlington, Ia.—The Peoples Gas & Electric Co. is reported to have decided to enlarge the gas plant.

Paducah, Ky.—The Paducah Light & Power Co. is reported incorporated with a capital of \$450,000.

Baltimore, Md.—Bids will be received until Nov. 22 by the Bd. of Awards (E. Clay Timanus, Pres.) for furnishing for the use of the Electrical Comm., about 1,000,000 duct ft. of conduit material, and 100,000 ft. special duct pipe. For further information, apply to Chas. E. Phelps, Jr., Ch. Engr., Electrical Comm.

Hamilton (Baltimore), Md.—The Hamilton Water, Light & Power Co. is reported incorporated, with a capital of \$35,000, to supply water and light to Hamilton and Lauraville.

Fall River, Mass.—The Fall River Electric Light Co. is reported to be preparing plans for a power station to be located on the easterly shore of Taunton River. Harry Bottomley, Supt., Fall River.

Woodmere, Mich.—The Edison Lighting Co., of Delray, is reported to be preparing to construct a plant in Woodmere, to supply the village with electric light.

Iron River, Mich.—The citizens are reported to have voted to issue \$30,000 bonds for constructing an electric light plant and rebuilding the water works.

***Ft. Wayne (Detroit), Mich.**—J. S. Farrell & Co., of Indianapolis, Ind., are stated to have secured the contract for the electrical construction of the barracks, guard house and gymnasium of the army post; they are also reported to have secured the heating and electrical contract for the Ft. Harrison Army Post, near Indianapolis.

***L'Anse, Mich.**—C. D. Shea, Village Clk., writes that the contract for constructing an electric light plant (bids opened Nov. 2) has been awarded to the Superior Constr. Co., of Houghton, for \$8,350.

Elk Rapids, Mich.—The Elk Rapids Light & Power Co. is reported incorporated, with a capital of \$25,000.

Cannon Falls, Minn.—The Cannon River Electric Power Co. is reported to have purchased the plant of the Northfield Light, Heat & Power Co. Power for the plant at Northfield and also the local plant, will eventually be transmitted from the dam to be built across Cannon River one mile west of the falls.

Newark, N. J.—The Essex County Park Comm. is reported to have decided to investigate the advisability of installing an electric light plant in Branch Brook Park.

Newark, N. J.—Bids will be received until Nov. 23 by the Joint Com. on Newark Free Bridges (John W. Roche, Chmn.) for substituting a steam plant for the electric plant now in use on the Jackson St. bridge, over the Passaic River, between the city of Newark and the town of Harrison.

***New Brighton, S. I., N. Y.**—T. Fred Jackson, 592 Columbus Ave., N. Y. City, has secured the contract for the electric equipment of School 16, Boro. of Richmond (bids opened Nov. 7) for \$4,457.

New York, N. Y.—Bids will be received until Nov. 20 by Maj. G. S. Bingham, Q. M., U. S. A., 39 Whitehall St., for furnishing and delivering f. o. b. factory about 55,000 incandescent electric lamps.

Buffalo, N. Y.—Bids will be received until Nov. 16 by the Dept. Pub. Wks. (Francis G. Ward, Comr.) for cable and placing same in conduits of the Niagara Falls Power Co., and Niagara Falls Hydraulic Mfg. Co., or of City of Buffalo, between Pumping Station and Ontario St. sub-station.

Amsterdam, N. Y.—Press reports state that the survey has been completed for steel tower line between Amsterdam and Ballston, a distance of 20 miles, preliminary to the construction of work necessary to the bringing of Hudson River Electric Power Company's Spier Falls power to Utica. The survey for the balance of the line from Amsterdam to Utica will probably be started next week.

Buffalo, N. Y.—The only bid received and opened on Nov. 3 by the Dept. of Pub. Wks. for installing cables in conduits is stated to have been submitted by the Robertson Electric Co. for \$82,748, according to specifications. It also submitted an alternate bid on a cheaper plan for \$57,641.

Roanoke Rapids, N. C.—H. C. Cooper, of Roanoke Rapids, Gen. Mgr. of the Roanoke Rapids Power Co., writes that engineers are now preparing plans for the power house and electrical installation. It is proposed to construct a dam across Roanoke River at this point, which for the first development will give the company about 9,500-hp. Later it is proposed to raise the dam so as to give about 25,000 hp. for 11½ hours per day; 3,500 hp. is already contracted for. C. P. E. Burgwyn, Engr. in Charge, with offices at Richmond, Va.

Fargo, N. D.—The gas and electric light plant at Fargo is reported to have been sold by Mainland Bros., to New York capitalists.

Forest, O.—The Town Council is reported to have decided to construct an electric light plant.

Haines, Ore.—J. F. O'Bryant is reported to have secured a franchise to construct an electric light plant.

Oregon City, Ore.—H. W. Hageman, of Stone City, Ore., is reported to have completed financial arrangements for the construction of an electric light and power

plant on Clackamas River at the old fish hatchery, about 7 miles above Oregon City, and he will build a 35-ft. dam and construct a large power plant. It is proposed to furnish light and power to Park Place, Gladstone, Clackamas Heights, Oregon City and Portland.

Eugene, Ore.—The City Council is reported to have employed Engineer Kelsey, of Salt Lake City, Utah, to make surveys, plans and estimates, for the proposed municipal electric light plant and water works, for which the citizens are reported to have voted to issue \$200,000 bonds. The site for the power plant is reported to have been selected on McKenzie River, about 30 miles east of Eugene.

W. T. Campbell, of Eugene, and associates are reported to be considering the construction of a power plant on McKenzie River in the vicinity of Waltherville, for the purpose of generating power for electrical purposes.

Gotebo, Okla. Ter.—The Gotebo Gas Co., of Gotebo, is reported incorporated, with a capital of \$5,000. Incorporators: John M. Kirkwood, M. F. Pierce and J. G. Hill.

Mitchell, S. D.—The Mitchell Gas Co. is reported to have secured a 20-yr. franchise.

Lawrenceburg, Tenn.—Jas. Dunn, City Secy.-Treas., writes that it is proposed to construct water works and an electric light plant, at a cost of about \$25,000. No engineer employed as yet.

Chattanooga, Tenn.—A 20-yr. exclusive franchise is for sale for water and electric light and power system, including rights of way, etc., as advertised in The Engineering Record. For further information address I. L. Faucett, Chamberlain Bldg.

Dublin, Tex.—The Dublin Gas & Electric Co. is reported incorporated, with a capital of \$50,000, by M. B. Templeton, of Waxachie, and J. F. Strickland, of Dallas.

Salt Lake City, Utah.—Francis M. Lyman, Jr., has filed an application with the County Comrs. for a franchise to erect poles and string wires along the county highways. He owns water rights on Mill Creek and proposes constructing a power plant.

Heber, Utah.—In addition to establishing an irrigation system to supply the settlers of Blue Bench on the Uintah reservation, the Blue Bench Co.-Operative Water Co. (Irwin E. Pratt, Secy.) also proposes furnishing electric light and power, and has filed application with the State Engineer at Salt Lake City for 200 second feet of water from Rock Creek in Wasatch County, which it proposes developing and submitting to Heber and elsewhere. The diverting canal will be 36,500 ft. long.

Ft. Hunt, Va.—Bids will be received until Nov. 16 by Lieut. Willis C. Metcalf, Constr. Q. M., U. S. A., Ft. Washington, Md., for furnishing and installing electric light fixtures in one single set of non-commissioned staff officers' quarters at Ft. Hunt.

Oakdale, Wash.—Mr. Shields, of Moscow, Idaho, is reported interested in the construction of an electric light plant at Oakdale.

Milwaukee, Wis.—Acting Mayor Corcoran on Nov. 3 signed the ordinance granting permission to the Central Htg. Co., to build tunnels and lay pipes throughout the city to do a general heating business.

Halifax, N. S.—The question of constructing municipal electric light plant is now being investigated. L. Fred. Monaghan, City Clk.

ELECTRIC RAILWAYS.

Notes Arranged Alphabetically by States.

Jonesboro, Ark.—The construction of an electric railway in Jonesboro is reported to be under consideration. W. W. Cate is reported interested in the project.

Stockton, Cal.—The Bd. of Dir. of the Stockton Elec. St. R. Co. is stated to have decided to make the road a standard gauge, and will at once begin work on the system. After the entire route in Stockton is changed the road will be extended into the adjoining counties, so as to make a complete interurban system to connect Stockton with the towns in San Joaquin and Stanislaus Counties.

Mattoon, Ill.—The Decatur, Sullivan & Mattoon Transit Co. is reported incorporated; capital, \$25,000. It is proposed to construct an electric railroad from Mattoon in a northwesterly direction to Decatur. Incorporators: R. J. M. Clokey, of Decatur; Geo. B. Spitzler, Mt. Zion; John R. Hamilton, of Mattoon, and others.

Jeffersonville, Ind.—It is stated that surveys have been started on a new road which it is proposed to build between Jeffersonville and Charlestown. The new line will be built next year by the Louisville & Southern Indiana Traction Co.

Petersburg, Ind.—The City Council is reported to have granted a franchise to the West Baden, Louisville & Vincennes Electric Ry., giving it the right to enter the city.

***Rushville, Ind.**—A contract is stated to have been awarded to Eshelman & Kaufman, of Anderson, to construct 5 sub-power stations on the lines of the Indianapolis & Cincinnati Traction Co. The first two will be built at Glenwood and Connersville.

Indianapolis, Ind.—The Chicago, Lafayette & Southeastern Traction Co., with a capital of \$100,000, is reported to have filed articles of incorporation. Directors: W. S. Reed, W. N. Harding, Martin M. Huggs, and others. The company proposes to build an electric railway to complete the last link in a chain of lines between Indianapolis and Chicago. This line will run from Lafayette to Kankakee, Ill., where it will connect with a road now building from Kankakee to Chicago.

Scottsburg, Ind.—The Louisville & Indianapolis Traction Co. is stated to have received a franchise for a right of way through Scottsburg.

Crown Point, Ind.—The Northwestern Indian Interurban & Street Ry. Co., of Crown Point, is stated to have filed articles of incorporation. Capital, \$10,000. The object of the company is to build an interurban line from East Chicago to Lowell, by way of Hammond,

Cedar Lake, Griffith, Hobart, St. John, Dyer and Crown Point. The company will also build and operate street cars in some of these cities. Geo. M. Bliss, Frank C. Knight and W. B. Wray are reported interested.

Chickasha, Ind. Ter.—Application is stated to have been made to the City Council for a franchise for an electric street railway system. J. G. V. Redmon, W. T. Crosless, W. S. Jones and W. G. Shannon are reported interested.

Osawatimie, Kan.—The City Council is stated to have passed an ordinance granting an electric franchise to W. H. Murphy, of Osawatimie.

Boston, Mass.—The Railroad Com. is reported to have approved the extension of the Boston Elevated Ry. Co.'s tracks from the Mt. Auburn district, along the westerly shore of Fresh Pond, and in Concord Ave. to Belmont.

Attleboro, Mass.—The Taunton & Pawtucket St. Ry. Co. is stated to have petitioned for permission to double-track its system from Briggs Corner to the Rehoboth line. This is in accordance with the plan to build a new line from Attleboro to Providence.

Battle Creek, Mich.—The Battle Creek & Southeastern Ry. Co. is reported incorporated, with a capital of \$500,000, for the purpose of building a line from Coldwater to Battle Creek, a distance of about 30 miles, to be operated by any motive power other than steam engines. Wm. E. Ware and Edward F. Pangborn, of Battle Creek, and Howard H. Ziegler, of Columbus, are among the directors.

***Kansas City, Mo.**—The contract for the building of the proposed electric railway from Kansas City, to Lone Jack, and ultimately to Warrensburg, is stated to have been awarded to H. B. Harding, of Los Angeles, Cal.

Kansas City, Mo.—The Metropolitan St. Ry. Co. is stated to have acquired control of the dummy line here. The line will be reconstructed and equipped with electricity next spring.

Excelsior Springs, Mo.—W. A. Bell is stated to have under consideration the construction of an electric railway here to extend from the Milwaukee depot to the Regent Spring.

***Brooklyn, N. Y.**—The contract for constructing Section 2 of the Brighton Beach Improvement, bids opened Nov. 2 by the Brooklyn Grade Crossing Comm., has been awarded to Chas. Cranford, 44 Court St., for about \$506,000; this section is about 2½ miles in length. The entire work of Section 2 calls for 230,000 cu. yds. earth excav.; 43,500 cu. yds. retaining walls; 6 highway bridges; 150 tons girders and poles; overhead construction; 150,000 duct ft. vitr. clay conduits, 450 cu. yds. reinforced concrete and 600 cu. yds. cinder concrete arches on highway bridges; 12,500 lin. ft. wrought iron fence.

Springfield, O.—Harry Frey is reported to be securing right of way for his proposed line from Springfield to Cedarville, Jamestown and Wilmington.

Columbus, O.—The Columbus, Delaware & Marion Ry. Co. is stated to have announced that all right of way for the proposed extension from Marion to Bucyrus has been secured and that work is to start at once.

Portland, Ore.—The Portland Ry. Co., which has taken over the properties of the Portland Consolidated Ry. Co., is reported organized with F. I. Fuller, Portland, Pres. and Gen. Mgr.; G. L. Estabrook, Secy. and C. N. Huggins, Portland, Treas.

Nashville, Tenn.—The Nashville Interurban Ry. Co., which proposes building an interurban line from Nashville to Gallatin and from Nashville through Franklin and Columbus to Mt. Pleasant, is reported to have changed its plans, and accordingly has filed an amendment to its charter which provides for a branch line from some point south of Nashville, between Brentwood and Franklin, to Lewisburg.

Vancouver, Wash.—It is stated that the Vancouver & Suburban Ry. Co., which was incorporated with a capital of \$2,500,000 by W. H. C. Sugg and associates, for the purpose of constructing electric railway lines in and around Vancouver, Wash., will begin surveys at once.

Wellsburg, W. Va.—The Wellsburg & Washington Electric Ry. Co. is reported incorporated, with a capital of \$10,000, for the purpose of building an electric line from Wellsboro, W. Va., to Washington, Pa. Incorporators: H. G. Lasear, S. George, H. G. Emery and others.

Wheeling, W. Va.—The Wheeling Traction Co. is reported to be securing right of way and making surveys for a line from Bellaire to Shadyside and Glencoe. The same company will also build lines from Martin's Ferry to Brilliant and from Steubenville to Mingo.

London, Ont.—It is stated that the London St. Ry. Co. has decided to remodel the system.

RAILROADS.

Notes Arranged Alphabetically by States.

San Francisco, Cal.—The San Francisco, Idaho & Montana Ry. Co. (Wm. Peyton Mason, Pres.) is reported to have completed the financing of 210 miles of road, or the first division, which will be built by the San Francisco, Idaho & Montana R. R. Constr. Co., formed for the purpose. The first section will extend from the Snake River Valley in Idaho southwest to Winnemucca, Nev., where it will connect with the Southern Pacific; cost of the work reported to be about \$2,500,000. A steel bridge will be constructed across Snake River. The line will be laid with 80-lb. rails and will be standard in every way.

***Jefferson, Ga.**—The Gainesville & Athens Constr. Co., of Gainesville, is reported to have secured contracts for constructing branch lines for the Gainesville & Midland R. R. Co.; one from Jefferson to Athens, 19 miles, the other between Gainesville and Midland, 55 miles.

Gainesville, Ga.—Surveys are reported to have been completed for an extension of the Gainesville Midland Ry. Jas. J. Baldwin, Pres., Savannah.

Atlanta, Ga.—The proposed extension of the Atlanta & Carolina Ry. Co. from Atlanta to Conyers with branch line will be 40 miles in length; probable cost \$1,000,000. Bids for construction will soon be received. M. Mason,

*Items marked thus give the names of parties awarded contracts.

Ch. Engr.; M. T. Edgerton, Secy. and Mgr. both at 515 Prudential Bldg.

Galesburg, Ill.—The Galesburg, Milwaukee & Southern R. R. Co. is reported incorporated with a capital of \$20,000,000, to construct a railroad in the States of Wisconsin, Illinois and Missouri, from Milwaukee, Wis., to Louisiana, Mo. Robt. A. Young, Jr., of Galesburg, is reported interested.

Indianapolis, Ind.—The National Bridge Co., State Life Bldg., is reported to have secured the contract to build the masonry abutments for track elevation at West St. at \$3.45 per cu. yd., for concrete work and 65 cts per cu. yd. for excavation.

Tulsa, Ind. Ter.—The Atchison, Topeka & Santa Fe R. R. Co. (W. B. Storey, Ch. Engr., Topeka, Kan.) is reported to have asked the court at Muskogee to appoint an appraisal board to condemn a right of way from here to Shawnee, Okla. Ter., a distance of 120 miles. This will connect the branch between Independence, Kan., and Tulsa and the Oklahoma line at Shawnee.

Davis, Ind. Ter.—The directors of the Eastern Oklahoma division of the Santa Fe R. R. Co. (W. B. Storey, Ch. Engr., Topeka, Kan.) are reported to have decided to build 10 miles of road between Davis and Sulphur Springs.

Dubuque, Ia.—R. W. Edwards, Gen. Mgr., Dubuque, Iowa & Wisconsin R. R. Co., writes that it is proposed to construct a railroad from Dubuque to Platteville, Wis., about 32 miles in length. Bids for construction will be received about Jan. 1.

Independence, Kan.—The Pittsburg, Independence & Oklahoma R. R. Co. is reported incorporated by A. C. Stich, A. W. Shulthis, J. B. Ziegler and A. Steinmetz, of this city, and Chas. Mitchell, Cherryvale. The line of the proposed road will extend from Pittsburg, Kan., to Ponca City, Okla. Ter., through Independence.

Stearns, Ky.—The Kentucky & Tennessee R. R. Co. (Willard Griffith, Ch. Engr.) is to construct a bridge across Big Smith fork of Cumberland River; also 12 miles of railroads. Bids for construction to be received within 30 days.

Baltimore, Md.—See "Business Buildings."

Hyde Park, Mass.—The R. R. Comrs. are reported to have agreed on plans for abolishing the grade crossings on the Midland division of the New York, New Haven & Hartford R. R. (C. M. Ingersoll, Ch. Engr., New Haven, Conn.) at Fairmount Ave. and Bridge St. There will be a steel girder bridge over the railroad, and an arch bridge of masonry or concrete over Neponset River, Maple and Walnut Sts. will be carried under the steel bridge west of the railroad.

Pentwater, Mich.—The Pere Marquette R. R. Co. (C. A. Wilson, Ch. Engr., Cincinnati, O.) is reported to have under consideration the extension of the Pentwater branch from Pentwater to Manistee via Ludington.

Duluth, Minn.—H. F. Balch, of Minneapolis, is reported to have secured the contract for grading 112 miles of railroad for the Lake Superior & Southeastern R. R., from Duluth to Ladysmith, Wis.

The Duluth & Northern Minnesota R. R. Co. (John Miller, Vice-Pres. & Mgr., Cloquet, Minn.) is reported to be surveying for the extension of the line to a point near Crosse River, on the north shore of Lake Superior. It will be about 40 miles in length and cost about \$250,000. This road will eventually reach the Canadian border, where it can connect with the Canadian Northern Ry., making an all-rail road from Duluth to Port Arthur.

Minneapolis, Minn.—City Engr. Andrew Rinker, S. B. Bratager, Asst. Engr. Northern Pacific, and M. R. Rhame, Div. Engr., Milwaukee R. R., are reported to be considering the abolishing of grade crossings in Southeast Minneapolis.

Jersey City, N. J.—The Central R. R. of New Jersey (Jos. O. Osgood, Ch. Engr., Jersey City) is reported to have decided to build a new freight yard nearly a square mile adjoining the company's holdings at Communipaw. Nearly all this area will be filled in from the present shore line to the outer line fixed by the Riparian Comm. The yard will extend southerly from the present freight docks to a point opposite the foot of Phillips St. In connection with the yard several new piers will be built. One of them will be 1,100 ft. long. The filling in will be done slowly. The work will cost about \$1,500,000.

Brooklyn, N. Y.—See "Electric Railways."

Bellefontaine, O.—Press reports state that the N. Y. Central & Hudson River R. R. Co. (A. H. Smith, Gen. Mgr., New York, N. Y.) will expend about \$500,000 in the construction of additional yard sidings and shops here; also about \$1,000,000 in similar enlargements at Brightwood, Ind.

Oklahoma City, Okla. Ter.—The directors of the Oklahoma & Texas R. R. Co. are reported to have authorized their chief engineer, P. H. McCrickett, to organize a surveying party to go over the entire route of the proposed line from here to Wichita Falls, Tex.

Wilkesburg, Pa.—Freese & Sperling, Boro. Engrs., writes that nothing definite has yet been done toward abolishing the grade crossings on the Pennsylvania R. R. The borough is figuring out the damages before deciding whether they will abolish grade crossings or not.

Philadelphia, Pa.—Having received the approval of plans for the elimination of the Trenton Ave. grade crossings from Chief Webster, Chief Engr. Brown, of the Pennsylvania R. R. Co. is reported to have on Nov. 3 awarded the contract for this work as follows: To McMenamin & Sims, of Philadelphia, for grading and masonry, for the first section of the second track on the Petersburg branch, and Millard & McGraw Constr. Co., of Philadelphia, the second section of this improvement. The work, which is to be started immediately, is to be completed by April 15, 1906. This is the elevated work which must be done before the Reading Ry. can begin its elimination of grade crossings in that section of the city.

The citizens voted Nov. 7 to issue \$4,000,000 bonds for the abolition of grade crossings.

Cheraw, S. C.—A. G. Page, of Cheraw, Supt. Chesterfield & Lancaster R. R. Co., writes that the company is open for bids since Nov. 1 for the construction of its proposed extension from Ruby to Lancaster, about 20 miles; cost of proposed work about \$200,000; motive power to be steam. Engineer, C. H. Acott, of Ruby.

Rapid City, S. D.—The White River Valley Ry. Co. is reported to have filed with the Secy. of State a resolu-

tion of extension from its present Lyman County terminus to Rapid City, across the counties of Lyman, Stanley and Pennington. It also authorizes the purchase of land in Rapid City for depot and yard purposes.

Jackson, Tenn.—The Illinois Central R. R. Co. (A. S. Baldwin, Ch. Engr., Chicago, Ill.) is reported to have decided to construct a line from Jackson to Birmingham, Ala., a distance of 216 miles.

Memphis, Tenn.—At a recent conference between City Engr. J. A. Omberg, J. M. Brinkley, Chmn. Improv. Com. on the 14th and 15th Wards, and H. G. Fleming, Chmn. Ry. Co., it is reported to have been decided to remove at an early date, all surface and grade crossings. The crossings at Bway and Main St. and Bway and Rayburn Ave. will be given immediate attention. It is estimated that the cost of constructing subways at these two points will approximate \$70,000 each.

Basin, Utah.—Gid. R. Propper, of Basin, Pres. Grand Valley, Colorado River & South Pacific R. R. Co., writes that it is proposed to construct a railroad about 1,250 miles in length, down and along the Grand and Colorado Rivers to the head of Gulf of California, San Diego. San Diego is to be the coast terminus. The first part of the road to be constructed will be from Grand Junction, Colo., to the head of Colorado River in Utah, a distance of about 180 miles; probable cost of work will be about \$150,000,000. Engineer, A. L. Hartridge.

Deepwater, W. Va.—It is stated that the Deepwater R. R. (Wm. N. Page, Ch. Engr., Amsted, W. Va.) is to be extended westward to the lakes.

Milwaukee, Wis.—The Milwaukee Southern R. R. Co. is reported to be planning a new route into the city along the north bluff of Menomonee River.

Brandon, Man.—Press reports state that the Great Northern R. R. Co. (A. H. Hogeland, Ch. Engr., St. Paul, Minn.) is to construct a line into Manitoba, to be known as the Brandon, Saskatchewan & Hudson Bay R. R. Co.

Toronto, Ont.—The Grand Trunk R. R. Co. (J. Hobson, Ch. Engr., Montreal, Que.) is reported to have been petitioned to construct subways in Parkdale, a suburb of Toronto, in place of the present level crossings.

PUBLIC BUILDINGS.

Notes Arranged Alphabetically by States.

Linden, Ala.—Bids will be received until Nov. 21 by the Bd. Co. Comrs., for erecting a jail. A. L. Hasty, Probate Judge.

Fresno, Cal.—The citizens are reported to have voted Oct. 31 to issue \$75,000 bonds for a new city hall.

Atlanta, Ga.—Capt. L. D. White, Pres. Bd. of Trus. of the Gate City Guards, writes that it is proposed to erect an armory to cost about \$20,000. Architect not yet selected.

Kewanee, Ill.—It is reported that F. S. Miner has secured the contract to erect the fire station at a cost of \$40,000.

Evanston, Ill.—James Gamble Rogers, Ashland Blk., Chicago, and Chas. A. Phillips, 59 Clark St., Chicago, associate architects for the proposed public library to be erected at Orrington Ave. and Church St., Evanston, expect that contracts for construction can soon be let. The building will be 2 stories high, of Bedford stone, and is estimated to cost \$75,000.

Logan, Ia.—John Latsener, of Omaha, Neb., it is stated, has submitted to the Bd. of Superv., the estimated cost of erecting an entire new building for the court house, the main structure to cost \$60,000, and the boiler house, ventilating and heating, plumbing, etc., an additional \$25,000. The Bd. of Superv., it is stated, is considering the erection of an entire new structure or the remodeling of the present structure.

New Orleans, La.—Wm. C. Furber, of Philadelphia, Pa., it is stated, has submitted plans for a Carnegie Library, which is to be erected here, at a cost of about \$200,000.

Boston, Mass.—The Executive Com. of the New England Deaconess Assoc., it is stated, is considering the erection of a Deaconess Hospital at Longwood, at a cost of about \$50,000 and have \$35,000 available for the purpose.

Springfield, Mass.—Huey Bros., of Boston, it is stated, on Oct. 24, submitted the lowest bid for ventilating and heating the Hall of Records Bldg., at \$7,878.

The Directors of the City Library Assoc., it is stated, have appointed Prof. A. D. F. Hamlin, Prof. of Architecture at Columbia Univ., as advisory archt. in the preparing of plans for the new library for which Andrew Carnegie recently gave \$150,000.

Palmer, Mass.—Bids will be received until Nov. 15 by the Bldg. Com. (A. W. Warriner, Chmn.) for erecting an almshouse at Palmer Center.

St. Cloud, Minn.—Meyer J. Sturm, 84 La Salle St., Chicago, Ill., is preparing plans for remodeling the hospital at St. Cloud which is to cost \$25,000.

St. Paul, Minn.—The Directors of the Lutheran Hospital, it is stated, have accepted plans for a \$100,000 building to be erected in the near future.

St. Louis, Mo.—T. W. Hackett, 3013 Lucas Ave., it is stated, has secured the contract to erect the engine house at 9th St. and Allen Ave., at \$15,989.

Ft. Robinson, Neb.—Bids will be received until Nov. 20 by H. C. Whitehead, Q. M., for repairs to old signal and post-office building, No. 74, at this post.

Manchester, N. H.—F. S. Newman & Co., of Manchester, are preparing plans for a Catholic Orphanage for Bishop Delaney; probable cost, \$150,000.

Jersey City, N. J.—It is stated that bids will be received until Nov. 21 by the Bd. Chosen Freeholders, c/o H. Otto Wittppen, 320 Communipaw Ave., Jersey City, for erecting an almshouse, according to plans by C. Fred Long, 1 Montgomery St. The buildings include men's dormitory, 2½ stories, 50 x 100 ft.; administration bldg., 3½ stories, 55 x 80 ft. and women's dormitory, 2½ stories, 44 x 108 x 44 x 127 ft., all of brick and stone.

Middletown, N. Y.—Brown & Lowe, of Schenectady, it is stated, have secured the contract to erect a building for the treatment of chronic cases at the Middletown State Hospital, the cost to be about \$178,671.

Gowanda, N. Y.—Bids will be received by T. E. McGarr, Secy. State Comm. in Lunacy, Albany, until Nov. 22 for the construction, heating, plumbing, etc., of third floor of Nurses Home; remodeling steam and hot water trunk lines, Gowanda State Hospital at Gowanda, as advertised in The Engineering Record.

New York, N. Y.—The Bd. of Aldermen on Oct. 30 passed an ordinance authorizing the issue of \$115,000 additional to the \$175,000 available for the municipal lodging house which the Dept. of Charities intends erecting in 25th St. and 1st Ave.

The Bd. also passed an ordinance authorizing the issue of \$800,000 in addition to \$200,000 available for the purpose, permitting the Dept. of Charities to commence work on the tuberculosis hospital on Staten Island, which is to cost a total of about \$2,000,000.

Bids will be received until Nov. 20 by the Bd. Health (Thos. Darlington, Pres.) for furnishing material, making certain alterations, repairs and improvements to the Dept. Bldg., 55th St. and 6th Ave., Boro. Manhattan.

Oswego, N. Y.—Plans are about to be prepared by the State Architect at Albany for the proposed armory to be erected at W. 1st and Mohawk Sts., to cost about \$60,000.

Cincinnati, O.—Feitig & Lee, it is reported, have prepared plans for a \$30,000 Carnegie Library which is to be erected in Cumingsville, O.

York, Pa.—The plans prepared by City Engr. R. B. McKinnon, for the addition to the city hall, it is stated, have been approved.

Harrisburg, Pa.—It is reported that Coder & Miller, of Harrisburg, secured the contract to erect a building for dangerous patients and a building for the nurses at the State Insane Hospital at Harrisburg, at \$128,000.

Providence, R. I.—Bids will be received until Nov. 20 by the Joint Standing Com. of the City Council on City Property (Jere H. Hall, Chmn.) for erecting a fire station on Rumboldt Ave. Banning & Thornton, Archts., 87 Weybosset St.

Staunton, Va.—T. M. Smiley, Chmn. Bldg. Com., writes that the contract for erecting a county building on S. Augusta St. (bids opened Oct. 21) has been awarded to M. B. Stoddard, of Staunton, for \$16,251.

Richmond, Va.—It is stated that plans and specifications have been completed for a jail which it is proposed erecting here at a cost of \$50,000.

Seattle, Wash.—Clayton D. Wilson, Hancock Bldg., it is reported, has been engaged to prepare plans for the municipal building which is to be erected at 4th Ave. and Yesler Way, and is to be used for the city hall receiving hospital and police headquarters, the total cost of the building to be about \$175,000.

Cheyenne, Wyo.—It is reported that the Union Pacific R. R. (Dr. A. W. Barber, Physician of the R. R. at Cheyenne) is considering the erection of a hospital here.

BUSINESS BUILDINGS.

Notes Arranged Alphabetically by States.

San Diego, Cal.—Harrison Albright, it is stated, is preparing plans for a hotel which U. S. Grant, Jr., contemplates erecting in this city.

Los Angeles, Cal.—The F. Q. Engstrom Co., 525 Towne Ave., it is stated, has secured the principal contract for the erection of a 4-story brick hotel on Grand Ave. and 6th St. for Mrs. Antonia Heinzenman, at \$52,628.

The principal contract for the erection of a 2-story brick business building on Jefferson St. and Normandie Ave., has been secured by R. D. Whitte, at \$12,370.

Los Angeles, Cal.—The Los Angeles Crematory Co., it is stated, has been incorporated for the purpose of erecting a crematory at 1603 Grover St., adjoining Rose-dale Cemetery, the cost to be about \$50,000. Chas. C. Reynolds, 1221 Westlake Ave., is Pres. of the Co.

A. B. Benton, 114 N. Spring St. it is reported, is preparing plans for a 5-story business building to be erected at Bway, and First St., for the Manbury estate.

Morgan & Walls, Farmers & Merchants' Bank Bldg. it is stated, have prepared plans for a 6-story store and office building, to be erected on Bway, and 4th St., by A. Bumiller, at a cost of \$100,000.

Denver, Colo.—The Hendrie-Bolthoff Mfg. & Supply Co., it is stated, will erect a 2-story brick warehouse on Wynkoop and 16th Sts., to cost \$20,000. F. E. Edbrooke, 510 Opera House Bldg., is the archt.

It is stated that plans are being prepared for a 4-story building which is to be erected by the wholesale grocery firm of Spratlen & Anderson, at a cost of \$75,000.

W. C. Mead, it is stated, has awarded the contract to erect a 3-story brick and stone business block, on California and 16th Sts., to the Kirchof Lumber Co., at about \$31,000.

New Haven, Conn.—Gordon, Tracy & Swartwout, 244 5th Ave., N. Y. City, it is stated, have prepared plans for the marble bank which is to be erected next spring on Church and Crown Sts., by the Trus. of the Connecticut Savings Bank.

Wilmington, Del.—The DuPont Powder Co., it is stated, intends erecting a \$1,000,000 office building at 10th and Market Sts., this city.

Washington, D. C.—It is stated that a building permit has been granted to the Columbia Hotel Co., to erect an 11-story addition to the Raleigh Hotel, the cost to be about \$100,000. The Geo. A. Fuller Co., of N. Y. City, it is stated, are the archts. and builders.

Pensacola, Fla.—It is reported that almost a block in the principal business part of the city was destroyed by fire on Nov. 1. The buildings include the Brent Bldg., loss on which is said to be \$60,000, and the Blunt Bldg., loss \$25,000.

Zion City, Ill.—The contract to erect the passenger station at Zion City for the Chicago & Milwaukee Electric Co., it is reported, has been secured by Fritz Foltz, of Chicago, Ill., at about \$25,000.

Aurora, Ill.—The Thompson Transfer & Storage Co., it is reported, intends erecting a 3-story warehouse. J. K. Newhall may be able to give further information.

Monmouth, Ill.—The contract to erect the Monmouth Hotel, it is reported, has been awarded to Davis & Cochran, at \$41,852.

Bloomington, Ill.—It is reported that a \$100,000 Y. M. C. A. building is to be erected here. Campbell Holton may be able to give further information.

Mason City, Ia.—It is stated that the Trus. of the Iowa Odd Fellows Orphans Home, have accepted plans for the rebuilding of the home which was recently destroyed by fire. Appropriation, \$45,000.

Belleveue, Ia.—It is reported that Chicago, Milwaukee & St. Paul R. R. (D. J. Whittemore, Ch. Engr., Chicago, Ill.) intends erecting a rooming house here.

Des Moines, Ia.—The building at 316 Court St., owned by F. M. Hubbell & Sons, is to be remodeled at a cost

*Items marked thus give the names of parties awarded contracts.

of about \$20,000, and is to be occupied by M. Stern & Co., milliners, of Keokuk.
 *W. T. Mitchell & Co., 116 8th St., it is stated, has secured the contract to erect the Empire Theatre on 8th St., at a cost of about \$15,000.

Louisville, Ky.—It is reported that the Baltimore & Ohio Southwestern R. R. (D. D. Carothers, Ch. Engr., Baltimore, Md.) has decided to spend about \$250,000 in improving its freight terminals in this city. Plans and specifications, it is stated, are being prepared, and the improvements contemplated include the construction of new freight-handling warehouses, new yard and house tracks, additional trackage facilities and the securing of sufficient space to accommodate the business of the road in the city.

R. J. Tilford, City Bldg. Inspector, in his annual report, it is stated, has announced that N. Y. capitalists intend erecting a 25-story office building at Jefferson and 4th Sts.

Opelousas, La.—Bids will be received until Nov. 20 by the Bldg. Com. (John W. Lewis, Pres. and Chmn.), Opelousas Development and Improvement Co., for erecting a 3-story brick hotel. Honold & Gauthier, Archts., Abbeville.

*Baltimore, Md.—The Baltimore & Ohio R. R. Co. has awarded contracts for important works as follows: To W. J. Marson & Co., Akron, O., signal towers, coal and oil houses at Flushing Tunnel, Ravenna, Lowellville, Nova and Kent, O. To J. J. Walsh & Son, Baltimore, for the construction of two signal towers at Washington. They are to be 2 stories, the first built of brick and the second having copper facing, and they will be covered with tile roofs. To Holbert & Spedden, of Fairmont, W. Va., for a 4-stall engine house and ash pit at Bridgeport, O.; cost about \$10,000. To W. A. Liller, of Keyser, W. Va., a saw mill at Glenwood, Pa.; cost about \$14,000, and to Niedermeier & Restle, of Youngstown, O., for a 4-stall engine house, ash pit, coal tipples and turntable, all at Haselton, O., for about \$15,000.

The Directors of the Mercantile Bank, it is stated, have engaged Tormey & Leach, to prepare plans for a banking house to be erected at Baltimore St. and Carrollton Ave.

I. & S. S. Weinberg, it is stated, have applied for a permit to erect a 5-story brick warehouse at 109 W. German St., estimated to cost \$25,000. Louis Levi, archt.

Haverhill, Mass.—The Ancient Order of Hibernians, it is reported, intend erecting a 3-story brick block; estimated cost, \$40,000. Heber F. McKenna, Pres.

*Boston, Mass.—E. W. Clack & Co., 7 Water St., have secured the contract for erecting the Peoples Palace on Washington and E. Brookline Sts.; cost including heating, plumbing and lighting which also have been let separate contract, is \$145,000. Architects, Brinard & Leeds, 8 Beacon St.

Grand Rapids, Mich.—It is stated that plans have been accepted for the 2-story stone depot which is to be erected here at a cost of \$50,000.

Minneapolis, Minn.—Harry W. Jones, 916 Lumber Exchange, it is reported, has prepared plans for a 6-story warehouse to be erected for Wyman Partridge & Co., at 7th St. and 3rd Ave.

Minneapolis, Minn.—Lester B. Elwood, it is stated, intends erecting a \$50,000 building at 2d Ave. S. and 6th St.

Clarksdale, Miss.—The Lodge of Elks, it is reported, have purchased a site, and intend erecting a building to cost \$20,000.

*Sedalia, Mo.—Thos. H. Johnson, of Sedalia, it is reported, has secured the contract to erect the Elks Home, a 3-story brick, steel and stone structure, to cost about \$40,000.

Kansas City, Mo.—C. A. Smith, Dwight Bldg., has prepared plans for a brick store building to be erected at 1009 Grand Ave., to cost \$19,000.

J. J. Swofford is reported to have decided to erect a hotel on 9th and McGee St., at a cost of \$150,000.

St. Louis, Mo.—The May Mercantile Co., it is stated, has secured a permit to erect additions to its store at a cost of about \$100,000.

The German-American Press Assoc., it is reported, intends erecting a 14-story building to be used by the various German newspapers, and has had plans prepared for same by H. E. Roach & Son, Chemical Bldg. John Schroers is Bus. Mgr. of the Assoc.

St. Louis, Mo.—The members of the Business Men's League, it is reported, are considering the rebuilding of the coliseum at a cost of \$175,000.

Omaha, Neb.—Archts. Fisher and Lawrie, Paxton Bldg., write that bids will be taken for the construction of a 5-story brick and stone Y. M. C. A. building, beginning Nov. 4 for about 2 weeks.

The members of the Elks Lodge, it is stated, have decided to erect a club house at a cost of \$100,000.

New Brunswick, N. J.—The New Brunswick Opera House Co., it is reported, has been incorporated, with a capital of \$25,000, to erect and conduct a theatre. Incorporators: Vanderbilt S. Voorhees, of Highland Park, N. J.; Chas. O'Connor of New Brunswick, and others.

Collinwood, N. Y.—The Lake Shore R. R. officials, it is reported have given a site and \$25,000 toward the erection of a Y. M. C. A. bldg. in Collinwood.

Brooklyn, N. Y.—Plans have been filed for a 3-story brick addition to stockhouse to be erected on Evergreen Ave. and Monteith St., to cost \$40,000. Owner, S. Liebmann's Sons Brewing Co., Bremen & Forrest Sts.; T. Englehardt, Archt., 905 Bway.

Albany, N. Y.—The Albany Garage Co., it is stated, has purchased the site at 28 and 30 Howard St., and intends erecting a 4-story brick garage.

Grand Forks, N. D.—The Elks, it is stated, are considering the erection of a lodge hall to cost about \$20,000.

*Dayton, O.—The Noel Constr. Co., of Baltimore, Md., it is stated, has secured the contract to erect a 12-story, 135 x 225-ft. steel frame fireproof building for the National Cash Register Co., at Dayton, at a cost of about \$1,000,000.

Cincinnati, O.—The Cincinnati Realty Co., it is stated, has been granted a permit to erect the Hotel Sinton, a 9-story structure on the Pike site on 4th St., the estimated cost to be \$1,000,000.

It is stated that a permit has been granted to J. A. Andrews, of Newport, Ky., to erect a 10-story store and office building at 5th and Race Sts., at a cost of \$150,000. It is to be of steel, brick and terra cotta construction.

Cleveland, O.—The Mall Bldg. Co., it is stated, intends erecting a building at Bond and Superior Sts., to be known as the Mall. It is stated that about \$200,000 will be expended on the building.

A. A. French, Cuyahoga Bldg., it is stated, is the archt. for the fireproof hotel which is to be erected by W. E. Ambler, at a cost of about \$60,000.

Mansfield, O.—R. G. Otterman, of Cleveland, it is stated, is interested in the erection of a \$15,000 skating rink in this city.

Reading, O.—Bids will be received until Nov. 15 by the Trus., Bd. Pub. Affairs (F. H. Vorjohan, Pres.) for enlarging and altering the power house of the Reading Waterworks and Electric Light Plant. Geo. Hornung, Engr., 612 Johnston Bldg., Cincinnati.

Columbus, O.—The Brennenman Baking Co., it is stated, has taken out a permit to erect a 2-story bakery at a cost of \$35,000.

Niles, O.—It is reported that W. C. and Katherine Allison have purchased the Sanford House, and intend erecting a hotel on the site to cost \$50,000.

Oklahoma City, Okla. Ter.—It is stated that \$40,000 building is to be erected next spring for the Western Newspaper Union at Harvey and 2d Sts.

Pendleton, Ore.—Jos. Basler and Geo. K. Reed, it is reported, have reached an agreement whereby they intend erecting a \$75,000 building.

Colon, Panama.—Bids will be received until Nov. 23 by Alfred Anderson, Asst. Purchasing Agt., Panama R. R. Co., 24 State St., New York, for the construction of a fireproof (either reinforced concrete or steel construction) building for cold storage purposes, to be erected at Colon, as advertised in The Engineering Record. All material but steel to be furnished by this company.

Eric, Pa.—J. N. Sapper, it is stated, intends erecting a 3-story brick or granite store, and office building on State and 11th Sts.

Pittsburg, Pa.—A building permit has been granted to Vincent, Scott & Co., to erect a 6-story brick and steel warehouse on Penn Ave. and Beatty St., at a cost of \$100,000, also to the Central District & Printing Telegraph Co., to erect an 8-story brick telephone exchange and office building on N. Montour way and 7th Ave., to cost \$100,000.

Philadelphia, Pa.—Chas. S. Purves, it is stated, has purchased a site on Water and South Sts., and intends erecting a 3-story warehouse to cost about \$25,000.

*A building permit has been granted to Jos. Perna to erect a 1-story concrete hall at 713 Christian St. for F. A. Giannini, at a cost of \$25,800.

Homestead, Pa.—The Pennsylvania R. R. Co. (W. H. Brown, Ch. Engr., Philadelphia, Pa.), it is stated, is having plans prepared for a freight station and warehouse which is to be erected on West St.

*Knoxville, Tenn.—Thomas & Turner are stated to have the contract for erecting a club house for the Cumberland Club at Clinch Ave. and Walnut St. Cost, \$30,000. Mathews & Broome, archts.

Beaumont Bros., 612½ Gay St., are the archts. for the proposed 6-story brick warehouse for J. W. Borches on W. Jackson Ave.

Memphis, Tenn.—Archt. John Gaisford, of Memphis, writes that bids will probably be viewed in the early spring for a business college for Macon & Andrews, to cost about \$60,000 or \$75,000.

It is stated that plans are to be prepared for an 8-story loft building, which is to be erected at Front and McColl Sts., of brick, iron and concrete, at a cost of about \$60,000. J. H. & J. W. Draughon, Real Estate dealers, may be able to give further information.

The Directors of the Young Men's Hebrew Assoc., it is stated, has appointed a Bldg. Com. of which Henry D. Bauer is Chmn. to have charge of the erection of its proposed new club building.

Salt Lake City, Utah.—The following are reported to be the lowest bids received for erecting the Masonic Temple: Masonry, Marron & Baker, \$9,000; carpentry work, Oliver Hodgson, \$25,000, and plastering, Abraham & Sullivan, \$7,000.

Bellingham, Wash.—Alsop Bros., it is stated, have perfected plans for a 4-story business block to be erected at Elk and Holly Sts., at a cost of \$75,000.

Seattle, Wash.—Saunders & Lawton, New York Bldg., it is stated, are the archts. for a 4-story and basement brick and stone business block which is to be erected on 2d Ave. S. and Washington St., at a cost of about \$30,000. R. C. McCormick, owner.

It is stated that plans have been prepared by Saunders & Lawton, New York Bldg., for a theatre which it is proposed erected at Union St. and 4th Ave., at a cost of about \$100,000.

Tacoma, Wash.—P. H. Hebb, it is stated, intends erecting a 7-story brick and stone bachelor apartment hotel on St. Helens Ave., the cost to be about \$100,000.

Spokane, Wash.—Mrs. August Kaiser, it is stated, intends erecting a 3-story brick building on Main Ave., estimated to cost \$20,000.

*Vancouver Barracks, Wash.—Contracts for constructing infantry barracks, Lieut.'s quarters and Captains' quarters at this post, including plumbing, heating and wiring (bids opened Oct. 20) has been awarded to J. D. Tresham, of Portland, Ore., for \$162,880.

*Ashland, Wis.—T. E. Pugh, of Ashland, it is reported, has secured the contract to erect the 2-story club house for the Elks, the cost to be about \$20,000.

Milwaukee, Wis.—It is stated that a 7-story building is to be erected at Buffalo and E. Water Sts., for the John Hoffman Sons' Co., at a cost of \$150,000.

Wauwatosa, Wis.—The Lutherans of Milwaukee, it is reported, are considering the erection of an old peoples' home here, and have \$25,000 available for the purpose.

CHURCHES AND DWELLINGS.

Notes Arranged Alphabetically by States.

Denver, Colo.—Wm. J. Hanagan, it is stated, has had plans prepared for a 4-story apartment house which he intends erecting at a cost of \$30,000.

Colorado Springs, Colo.—W. M. Hager, it is reported, intends erecting a residence at 1300 N. Cascade Ave., to cost about \$20,000.

Westhaven, Conn.—The erection of a new edifice for Christ Church to cost about \$50,000 is reported under consideration.

*Augusta, Ga.—J. H. McKenzie's Sons, of Augusta, are stated to have secured the contract for erecting the edifice for the Second Presbyterian Church; cost, \$30,000.

Evanston, Ill.—It is reported that P. L. McKinnie & Son are preparing to erect a \$100,000 apartment house at Hinman Ave. and Kenzie St.

Bloomington, Ill.—The Trus. of the Lucretia M. E. Church (Chas. T. McCarty, Pres.), it is reported, are considering the erection of an edifice to cost about \$30,000.

Tulsa, Ind. Ter.—The members of the Baptist Church, it is reported, are considering the erection of an edifice to cost \$15,000.

Muskogee, Ind. Ter.—It is reported that Maj. A. W. Patterson is having plans prepared for a residence which he intends erecting at a cost of about \$20,000.

Des Moines, Ia.—It is stated that Lowell Chamberlain intends erecting an \$18,000 flat at W. 18th St. and Grand Ave.

Baltimore, Md.—Plans have been filed for a 5-story brick tenement which it is proposed erecting at Sterling Pl. and Saratoga Ave., at a cost of \$40,000. Owner, Saratoga Heights Co., 1778 Pitkin Ave.; F. Bucher, archt., 1778 Pitkin Ave.

Springfield, Mass.—August Pritzlaff, it is stated, has purchased a site at Main and Cross Sts. and intends erecting an apartment house.

*Fall River, Mass.—The contract for the new St. Anne R. C. Rectory has been awarded to the Granite Constr. Co., of Fall River; cost about \$65,000. Rev. P. Charland, Archt., St. Anne Church.

St. Louis, Mo.—It is reported that the members of St. Margaret's R. C. Church are contemplating the erection of a new edifice at Vandewater and Flad Aves., at a cost of about \$68,000. Rev. J. J. O'Brien, pastor.

South Omaha, Neb.—It is reported that plans have been prepared for an edifice for St. Bridget's Church, the cost to be about \$25,000.

*Asbury Park, N. J.—T. H. Prior & Sons, of Trenton, it is stated, have secured the contract to erect a stone edifice for the First Baptist Church at Asbury Park, the cost to be about \$50,000.

*West Hoboken, N. J.—The Crane-Giles Co., of N. Y. City, it is stated, has secured the contract to erect the brick edifice and parish house for the First Reformed Dutch Church at Palisade Ave. and Maple St., to cost \$25,000.

Toledo, O.—Mr. Hollenbeck, State Fire Marshall, it is reported, intends erecting a flat at Madison and 16th Sts., at a cost of \$25,000.

*Philadelphia, Pa.—Ashton S. Tourison, 6805 Germantown Ave., it is stated, has secured the contract to erect a stable and garden house on the estate of J. Levering Jones at Chestnut Hill, at a cost of \$16,500.

Norfolk, Va.—It is reported that the Italians of Norfolk are contemplating the erection of an edifice to cost about \$20,000. Rev. Father Louis Guzzardi, pastor.

Richmond, Va.—The Trus. of the Church of the Covenant, it is stated, have been authorized to issue \$15,000 to erect a new edifice.

*Seattle, Wash.—Clifford & Murdock, it is stated, have secured the contract to erect a residence for O. O. Denny at Seneca St. and Boren Ave., at a cost of about \$12,000. Bebb & Mendel, Denny Bldg., are the archts.

*Milwaukee, Wis.—It is reported that contracts have been awarded as follows for the \$100,000 flat which is to be erected for Mrs. Caroline Scamman, at Milwaukee and Martin Sts.; Masonry, to Riessen & Wilke; carpentry to Edmund Schultz, and iron work to the Colnik Mfg. Co.

Cheyenne, Wyo.—The Jewish residents of the city, it is stated, are contemplating the erection of a synagogue to cost about \$12,000. Harry Fleischman is secy. of Com.

Montreal, Que.—A building permit has been granted to Wm. Hope to erect a 3-story brick and stone residence on Dorchester and Sussex Sts., to cost \$28,000.

SCHOOLS.

Notes Arranged Alphabetically by States.

Red Bluff, Cal.—A site has been selected on which it proposed erecting the \$30,000 high school.

San Jose, Cal.—See "Sewerage and Sewage Disposal."

Waycross, Ga.—The Trus. of the proposed Baptist College, which is to be erected here, it is stated, have appointed a com. to receive plans and bids for the construction of the buildings. It is stated that the main building will cost about \$15,000, and the 2 dormitories about \$5,000.

Albany, Ga.—Bruce & Everett, of Atlanta, it is reported, have completed plans for the \$25,000 school which it is proposed erecting here.

Atlanta, Ga.—The Bd. of Educ., it is stated, is considering the erection of a school in the 2d Ward at Pryor and Ormond Sts., the cost to be about \$30,000.

Decatur, Ill.—The Ursuline Sisters, it is reported, have secured a site and intend erecting an academy, to cost \$75,000.

Naperville, Ill.—The Northwestern College of Naperville, it is reported, has received a donation of \$50,000 for the erection of a science building.

Chicago, Ill.—D. H. Perkins, architect for the Board of Educ. has completed plans for an addition to the Curtis school at State and 114th Sts. The building will be a 3-story structure of fireproof construction and will cost \$100,000.

*Manhattan, Kan.—John F. Stanton, State Archt., Topeka, writes that the contract for erecting horticultural bldg. at State College (bids opened Nov. 7) has been awarded to Stingley Bros., of Manhattan, Kan., for \$35,380, not including heating, plumbing or lighting.

Hopkinsville, Ky.—Jas. L. Long, of Hopkinsville, is reported to be preparing plans for rebuilding the girls' dormitory at South Kentucky College, which was destroyed by fire on Nov. 2.

Baltimore, Md.—The following are reported to be the bids received Nov. 1 by the Bd. of Awards for erecting School No. 10 at Hollins and Amity Sts.: John A. Sheridan Co., \$36,615; Henry S. Rippel, \$36,205; Milton C. Davis, \$34,380; Chas. A. Stockhausen, \$39,687.

*Items marked thus give the names of parties awarded contracts.

Kalamazoo, Mich.—U. M. Arnold, Archt. of the Western State Normal School in this city, it is stated, is preparing plans for a new building which is to be erected west of the present structure, the cost to be about \$60,000.

White Earth, Minn.—Bids will be received until Nov. 27 by Simon Michelet, U. S. Indian Agt., White Earth, for furnishing and delivering about 45,913 ft. assorted lumber, 18,000 shingles, 1,600 lbs. nails, 600 lbs. white lead, builders' hardware, brick, etc., required to construct and repair buildings at the Wild Rice River Boarding School, White Earth Agency.

Laurel, Miss.—Bids will be received until Dec. 7 for erecting a 2-story brick school. Bids on building, heating, plumbing and wiring are to be submitted separately. W. F. Daly, City Clk.

Princeton, N. J.—J. W. Cooney, it is stated, has secured the contract for the plumbing in dormitory at Princeton Univ., at \$6,297, and Banker, Smith & Co. the contract for the heating of same at \$6,425.

Kreischerville, S. I., N. Y.—Bids will be received until Nov. 20 by C. B. J. Snyder, Supt. of School Bldgs., N. Y. City, for the general construction of additions to and alterations in school No. 4, at Kreischerville, and for installing ventilating and heating apparatus in addition to school No. 23; Mariner's Harbor, both in the Boro. of Richmond.

Ticonderoga, N. Y.—It is stated that bids will be received by the Bd. Educ. (F. B. Wickes, Pres.) until Nov. 22, for erecting a high school.

Long Island City, L. I., N. Y.—Jas. Fay's Son, 205 E. 51st St., N. Y. City, has secured the contract for sanitary work and gas fitting of School 37, Queens Boro. (bids opened Nov. 6) for \$6,372.

Brooklyn, N. Y.—The following are the bids opened Nov. 6 by C. B. J. Snyder, Supt. School Bldgs., N. Y. City, for general construction, etc., of School 42, Boro. of Brooklyn: Clarke & Stowe, \$252,300; John Auer & Sons, \$255,400; Thos. Cockerill & Son, \$274,500; Richard H. Carman, \$290,000; Chas. H. Peckworth, \$244,960; P. J. Walsh, \$243,000; Geo. Hildebrand, \$258,800; Church Constr. Co., 949 Bway., N. Y. City, \$243,000 (awarded contract); Jas. McArthur, \$322,000; Arci Constr. Co., \$246,000; and Richard E. Henningham, \$249,400.

New York, N. Y.—The following are the bids opened on Nov. 6 by C. B. J. Snyder, Supt. School Bldgs., for general construction of additions to and alterations in School 25, Manhattan Boro.; Francis Sullivan, \$86,000; P. Gallagher, 156 5th Ave., \$79,000 (awarded contract); Wm. Werner, \$96,589; Patk. Sullivan, \$87,690; Alfred Nugent's Son, \$87,790; Thos. Cockerill & Son, \$80,900; Thos. McKeown, \$99,447; Edmund D. Broderick, \$90,400; Fanning & Reilly, \$100,965; Geo. Hildebrand, \$92,400.

Jere J. Deady, 146 E. 16th St., has secured the contract for sanitary work and gas fitting of addition to School 10 (bids opened Nov. 6) for \$7,500.

New York, N. Y.—An ordinance was signed by the Mayor on Nov. 2 providing for the issue of corporate stock in the amount of \$3,000,000 to provide means for constructing, improving, equipping, etc., schools and additions thereto and the securing of sites in the City of New York.

Wooster, O.—It is reported that plans are being prepared for a \$60,000 dormitory to be erected at Wooster Univ.

Toledo, O.—It is stated that additions are to be erected at the Raymer, Glenwood and Ontario schools, the cost in each case to be about \$10,000.

Rossmoyne, O.—Bids will be received until Dec. 1 by the Bd. Educ., Amity Special School Dist. No. 9, Rossmoyne (L. E. Cox, Clk., Route No. 11, Lockland) for erecting a school on Amity Ave. Bids may be submitted separately or as a whole on the following: Excavation and masonry; brick work; cut stone work; roofing and sheet metal work; carpentry; heating (hot air system), etc.

Cincinnati, O.—Edw. H. Dornette, Pickering Bldg., it is stated, has completed plans for the first Intermediate school to be erected on Baymiller St., at a cost of \$150,000.

Sharpsburg, Pa.—It is reported that school bonds amounting to \$75,000 have been sold.

Munhall, Pa.—It is stated that school bonds amounting to \$25,000 have been sold.

Lancaster, Pa.—The Lancaster County Poor Directors, it is stated, have given a site on which to erect the Thaddeus Stevens Industrial school, for which there is \$138,000 available.

New York, N. Y.—The following are the bids opened Oct. 26 by the Comrs. of Parks for constructing that portion of St. Nicholas Park north of 135th St. and east of St. Nicholas Terrace, Boro. of Manhattan: (a) Geo. I. Bailey; (b) Culgin & Pace; (c) Cunningham & Kearns; (d) Bart Dunn, 444 E. 67th St. (awarded contract); (e) Wm. J. Flanagan; (f) John J. Hart Co.; (g) John J. Hopper; (h) P. J. Kane; (i) Kelly & Kelley (j) Arthur F. McGuiness; (k) Jas. Pilkington:

	a	b	c	d	e	f	g	h	i	j	k
14,000 cu. yds. earth excav.....	\$0.80	\$0.80	\$0.75	\$0.35	\$1.00	\$1.10	\$1.50	\$0.80	\$0.60	\$1.00	\$2.20
2,500 cu. yds. rock excav.....	2.50	3.00	2.00	1.50	3.00	2.50	4.00	2.50	3.00	3.00	3.20
500 cu. yds. borrowed fill in place.....	1.00	.50	.40	.01	1.00	.75	.20	1.10	.50	.01	.01
60 cu. yds. large, loose rock, to be removed.....	10.00	5.00	2.00	1.50	5.00	2.50	4.00	1.50	75.00	5.00	1.00
250 cu. yds. rustic rocks to be planted & doweled into bedrock.....	10.00	25.00	25.00	3.50	8.00	10.00	40.00	2.00	10.00	10.00	5.00
6,850 cu. yds. manure.....	2.50	1.00	1.25	2.25	2.00	1.50	2.00	1.80	2.00	2.00	.50
21,300 cu. yds. mold.....	1.50	2.50	1.20	1.60	2.00	1.50	1.50	1.40	1.35	1.50	1.625
375,000 sq. ft. sod.....	.04	.03½	.02	.01¾	.03	.03½	.02	.05	.01½	.02	.02
75 walk basins complete.....	50.00	50.00	60.00	44.50	47.00	70.00	100.00	50.00	70.00	75.00	50.00
20 surface basins complete.....	60.00	65.00	70.00	48.75	50.00	70.00	125.00	50.00	70.00	75.00	50.00
1 receiving basin complete.....	300.00	225.00	200.00	197.49	300.00	250.00	200.00	175.00	200.00	200.00	225.00
1,650 lin. ft. 6-in. vitr. drain pipe.....	2.00	1.75	2.00	1.15	2.00	1.60	1.75	.50	1.00	1.50	1.50
1,850 lin. ft. 8-in. vitr. drain pipe.....	2.50	1.85	2.25	1.32	2.00	1.60	2.00	.50	1.00	1.75	1.75
600 lin. ft. 10-in. vitr. drain pipe.....	3.00	2.35	2.50	1.55	2.00	1.60	2.30	.65	1.50	2.50	2.00
1,300 lin. ft. 12-in. vitr. drain pipe.....	3.50	2.75	4.00	1.75	2.00	1.75	3.00	.75	2.00	4.00	2.00
22 manholes to be built complete.....	100.00	110.00	100.00	150.00	75.00	70.00	70.00	100.00	200.00	60.00	50.00
6,500 lin. ft. 3-in. porous tile pipe.....	.10	1.60	.30	.22	.30	.60	.25	1.00	.30	.25	.20
Water supply system complete.....	6,000.00	7,500.00	9,000.00	8,000.00	15,000.00	9,700.00	10,000.00	6,000.00	20,000.00	10,000.00	6,800.00
425 lin. ft. new 5-in. curb.....	1.00	1.60	1.25	1.15	1.25	1.50	1.00	1.50	2.00	2.00	1.25
2,000 lin. ft. 2½-in. bluestone edging.....	1.50	.80	1.25	1.00	1.50	2.00	.85	1.25	.90	1.50	.50
100,000 sq. ft. asphalt walk pav't.....	.27½	.25	.25	.25	.30	.30	.22	.25	.20	.21	.15
1,200 cu. yds. rubble masonry in cement mortar.....	7.50	6.00	7.00	.60	7.50	12.00	3.00	6.50	7.00	6.00	4.90
5,650 lin. ft. new bluestone steps.....	2.00	2.25	1.75	1.35	1.50	3.50	1.25	1.25	2.00	1.75	1.50
1,000 lin. ft. bluestone checks.....	2.00	1.00	1.75	.80	1.50	2.25	.90	1.25	1.10	1.25	1.00
105 lin. ft. bluestone steps to reset.....	1.00	.40	1.00	.25	1.00	1.25	.50	.50	1.00	.50	.20
Repair old & furnish & erect new wrought iron picket fence.....	5,000.00	1,000.00	1,000.00	2,100.00	750.00	2,200.00	1,500.00	500.00	1,500.00	1,350.00	500.00
2,000 lin. ft. 3-rail pipe fence, with wire mesh screening.....	3.00	1.70	2.00	.70	2.50	3.50	1.10	1.35	1.50	1.25	1.50
2,150 lin. ft. 2-rail pipe fence, with wire mesh screening.....	2.40	1.20	2.00	1.50	2.50	2.75	1.00	1.35	1.25	1.10	1.00
Total.....	\$183,260	\$190,982	\$154,759	\$142,000	\$190,036	\$197,521	\$171,411	\$152,256	\$162,307	\$159,700	\$145,952

*Items marked thus give the names of parties awarded contracts.

Providence, R. I.—Bids will be received until Nov. 20 by the Joint Standing Committee of the City Council on city property (Jere H. Hall, Chmn.) for additions to and alterations in the Technical high school, Pond St. Martin & Hall, Archts., 806 Union Trust Co. Bldg.

Huron, S. D.—It is stated that Ralph Voorhees, of Clinton, N. J., has given \$100,000 to Huron College, with which it is proposed erecting a new central building, to be known as Ralph Voorhees Hall. Calvin H. French, Pres.

Humboldt, Tenn.—It is reported that plans and specifications for the new school have been accepted by the Bldg. Com. of the Bd. of Educ. (Mayor J. C. Adams, Chmn.) and it is stated that bids for its erection are to be received until Dec. 14. L. M. Weathers Co., of Memphis, are the archts.

Jacksonville, Tex.—It is stated that bids will be received until Nov. 15 by the Bldg. Com., Alexander Collegiate Institute for erecting a 3-story brick or concrete college building. C. E. Jaques, Archt., Jacksonville.

Lynchburg, Va.—It is stated that a dormitory is to be erected at the Randolph-Macon College at Lynchburg, the cost to be about \$30,000. It is also reported that the erection of a science hall in the near future is under consideration. Dr. W. W. Smith, Dean.

Seattle, Wash.—It is stated that Jas. Stephen, 727 New York Bldg., has been engaged to prepare plans for the high school which is to be erected in the Interlake Dist. It is stated that bids for the construction will be asked probably in Dec. The cost is reported to be about \$150,000.

A site has been secured on Queen Anne Hill on which it is proposed erecting a high school, the cost about \$150,000, as soon as the Interlake school is completed.

Behlman, W. Va.—C. C. & A. L. Thayer, of New Castle, Pa., it is reported, have completed plans for the Carnegie Library, which is to be erected at Bethany College, at a cost of about \$20,000. Rev. T. E. Cramblett, Pres.

Wheeling, W. Va.—The citizens of the county, it is stated, have voted in favor of issuing \$50,000 school bonds, \$41,000 to be used to erect a new school at Elm Grove and \$9,000 to erect an addition to school at Edgington.

Toronto, Ont.—A new building is to be erected at the Toronto Univ. at a cost of about \$15,000, to be used as a school of expression.

STREET CLEANING AND GARBAGE DISPOSAL.

Notes Arranged Alphabetically by States.

Lexington, Ky.—It is proposed to construct a garbage crematory. J. C. Garrick, Pres. Bd. Health; Thos. Combs, Mayor.

Grand Rapids, Mich.—Bids will be received by John L. Boer, City Clk., until Nov. 27 for the construction of an 80-ton garbage crematory, as advertised in The Engineering Record.

Brooklyn, N. Y.—Bids will be received until Nov. 16 (readvertisement) by John McG. Woodbury, Comr. Street Cleaning, New York City, for furnishing material and removing snow and ice by or before April 15, 1906.

New York, N. Y.—The following are the bids opened Nov. 6 by John McG. Woodbury, Comr. Street Cleaning, for the final disposal of garbage in Manhattan Boro. for 5 yrs: New York Sanitary Utilization Co., 3 Burling Slip, \$148,000 each yr.; Darling & Co., Produce Exchange, \$209,000 each yr.; American Reduction Co., 26 W. 26th St., \$154,000 each yr.; E. J. McKean, 105 6th Ave., \$300,000 for 1st and 2d yr., and \$320,000 for the 3d, 4th and 5th yrs.

NEW INDUSTRIAL PLANTS.

See also Business Buildings.

Roberts, Roop & Co., Westminster, Md., will rebuild at once their mill which was recently burned.

L. W. Pond Machine Co., Worcester, Mass., will build a new foundry, to measure 40 x 88 ft., according to local reports.

Enterprise Iron & Wire Wks., Baltimore, Md., have purchased site for a new plant, according to local newspaper reports.

Mount Vernon Brewing Co., Baltimore, Md., will shortly begin the erection of a new bottling house, to measure 72 x 40 ft.

M. Calm & Bro., New York City, mfrs. of chemicals, have purchased site in Jersey City for a new plant, according to local reports.

Hillside Coal & Iron Co., Wilkesbarre, Pa., will erect a new washery at the Hillside colliery, Avoca, according to local newspaper reports.

Aldridge Lumber Co., Rockland, Tex., will build a new plant. Power plant consisting of one engine and three boilers will be installed.

American Spiral Pipe Works, Chicago, Ill., will erect a new plant at Cicero, to cost about \$150,000, according to local newspaper reports.

Hiernan-Hughes Co., Jersey City, N. J., have completed plans for a new paper box factory, to cost \$30,000, according to local newspaper reports.

T. F. Stroud & Co., Omaha, Neb., have secured site for a plant, for the manufacture of grading machinery, according to local newspaper reports.

Worcester (Mass.) Cold Storage & Warehouse Co. have purchased site for an extensive new plant in that city, according to local newspaper reports.

The Hetherington & Berner Co., Indianapolis, Ind., mfrs. of paving materials and tiles, will erect a new plant in that city, according to local reports.

Glenn Mfg. Co., St. Charles, Ill., mfrs. of pipe, fittings, iron supplies, etc., has begun the erection of a new foundry building, to measure 80 x 180 ft.

The Iroquois Iron Co., Chicago, Ill., has purchased a tract of land on which it will erect a \$1,000,000 blast furnace plant, according to local newspaper reports.

The Proctor & Gamble Co., Cincinnati, O., are having plans prepared at their Cincinnati office for the erection of a very large soap works on Staten Island, N. Y.

The Concrete Construction Co., Houston, Tex., has recently been organized and is contemplating the erection of a plant for the manufacture of concrete building blocks, according to local newspaper reports.

Skedden Brush Co., Ltd., Hamilton, Ont., will build a new plant. The main building will measure 130 x 40, 2 stories high, with basement. The plant will be operated by electricity, 15 to 20 hp. being required.

Mr. Geo. Hornung, Consulting Engineer, Cincinnati, O., is preparing plans for the Herancourt Brewing Co., of that city, covering the reconstruction of their steam and refrigerating plants and the modernizing of their electrical plant.

South Atlantic Waste Co., Charlotte, N. C., will begin at once the erection of a new plant, which will cover an area of 30,000 sq. ft. Details of the equipment have not yet been fully worked out. This company was recently organized with a capital of \$250,000.

Scullin-Gallagher Iron & Steel Co., St. Louis, Mo., is erecting a new plant to have a capacity of 100 tons of finished castings per day. Four buildings will be erected and four 20-ton basic open hearth furnaces will be installed, together with complete equipment of electric traveling and pneumatic jib cranes. The cleaning room will be provided with complete outfit of sand blast machinery, jumpers, planers, lathes, emery wheels, etc.

Sealed proposals will be received at office of the Asst. Purchasing Agt., Panama Railroad Co., 24 State St., New York, until 2 P. M., Nov. 23, for the construction of a fireproof (either reinforced concrete or steel construction) cold storage building, to be erected at Colon, Panama. All material except steel to be furnished by railroad company. Full particulars may be obtained from Alfred Anderson, Asst. Pur. Agt., 24 State St., New York.

MISCELLANEOUS.

Notes Arranged Alphabetically by States.

San Jose, Cal.—See "Sewerage and Sewage Disposal."

Washington, D. C.—Bids will be received until Dec. 5 at the Bureau Supplies and Accounts, Navy Dept., Washington, D. C., to furnish at the Navy Yards, Boston, Mass.; New York, N. Y.; League Island, Pa.; Norfolk, Va.; and Pensacola, Fla., a quantity of machine tools as follows: Schedule 220: Emery grinding, lathe, molding and pipe-cutting machines and shaper. Schedule 221: Band sawing and pattern machines, carter, cut off and rip saw. Schedule 222: Planer, pneumatic drills, grinders, drills, metal and scroll saws, steam and power hammers, centering and milling machine and gas lather. Applications for proposals should designate the schedule desired by numbers. H. T. B. Harris, Paymaster Gen., U. S. N.

Washington, D. C.—See "Power Plants, Gas and Electricity."

*Savannah, Ga.—G. Reuben Butler, Clk. Co. Comrs., writes that the contract for constructing a lock at the outlet of Casey dam (bids opened Oct. 23) has been awarded to Southern Concrete Constr. Co., of Savannah, for \$4,502.

Logansport, Ind.—Press reports state that the Comrs. of Cass County will receive bids for the construction of the Bradford ditch in Cass County.

Independence, Kan.—The Cudahy Pipe & Oil Refining Co. is reported organized with John Cudahy, Pres., Chicago, Ill.; Albert J. Nathan, Secy., New York, N. Y.; W. D. Todd, Gen. Mgr., Warren, Pa. The company is reported to have a capital of \$6,000,000, with main office in the Commercial Bldg., St. Louis. A refinery of 6,000 bbls. capacity will be constructed at once along the river south of St. Louis. The 6-in. pipe line from Bartlesville, Ind. Ter., to the refinery will be 365 miles in length. There will be a pumping station at Bartlesville, one at Alluwee and 4 or 5 in Missouri.

Curtis, La.—It is reported that bids will be received by T. N. Braden, of Curtis, for levee work in Bossier Parish, about 60,000 cu. yds.

Jersey City, N. J.—See "Railroads."

*New York, N. Y.—The Godwin Constr. Co., 60 Wall St., has secured contracts for repairing the pier and landing wharf at Swinburne Island, Quarantine, and for rebuilding the bulkhead at the coal plant of John S. Bush, on Westchester Creek.

Tarrytown, N. Y.—Bids will be received by Col. W. R. Livermore, Corps Engrs., U. S. A., Army Bldg., N. Y. City, until Nov. 27 for dredging in Tarrytown harbor, as advertised in The Engineering Record.

New York, N. Y.—Bids will be received by Col. W. R. Livermore, Corps Engrs., U. S. A., until Nov. 22, for dredging in South River, Woodbridge Creek, Keyport Harbor, School Harbor and Compton Creek, N. J., as advertised in The Engineering Record.

Bids will be received until Nov. 20 by Maurice Featherston, Comr. Docks, for furnishing and delivering about 6,000 cu. yds. sand; also machinists' supplies, iron, steel, etc., both in Boro. Manhattan.

Cincinnati, O.—Bids will be received until Nov. 27 by the Bd. Pub. Service (Geo. T. Holmes, Clk.) for constructing re-inforced concrete retaining walls on the site of the new Cincinnati Hospital, Goodman St. and Eden Ave. Saml. Hannaford & Sons, Archts., Hulbert Bldg.

Panama.—Bids will be received until Nov. 24 by the Isthmian Canal Comn. (D. W. Ross, Gen. Purchasing Agt.), Washington, D. C., for furnishing shop, machinery lathes, planers, saw and timber dressing machine, drills, engine, sheet steel, pressure gauges, engine indicators, etc.

Philadelphia, Pa.—Specifications are on file at the office of The Engineering Record, 114 Liberty St., New York, N. Y., for deepening and improving channel of Delaware River, between the city and Delaware Bay, and bids will be received by A. Lincoln Acker, Dir. Dept. Pub. Wks., until Nov. 24, as advertised in The Engineering Record.

Norfolk, Va.—Bids will be received until Dec. 9 by Mordecai T. Endicott, Ch. Bureau Yards and Docks, Navy Dept., Washington, D. C., for an electric freight elevator in storehouse, for torpedo boat outfits as per specification No. 1471.

Newport News, Va.—The following are the bids opened on Nov. 2 by Capt. E. Eveleth Winslow, Corps Engrs., U. S. A., for removing wreck of bark J. D. Bischoff, off Newport News: G. M. Van Sant, Norfolk, \$2,960; H. W. Phillips, Quincy, Mass., \$4,500; W. H. French, Berkeley, \$1,390; Coastwise Dredging Co., Norfolk, \$943, and Chas. Johnson, Lewes, Del., \$1,473.

Wheeling, W. Va.—Bids will be received by Maj. Geo. A. Zinn, Corps Engrs., U. S. A., until Dec. 12, for building Dam 13, Ohio River, about 6 miles below Wheeling, as advertised in The Engineering Record.

Milwaukee, Wis.—The Chicago, Milwaukee & St. Paul R. R. Co. is reported to have decided to expend about \$50,000 on docks, near the junctions of Milwaukee and Memoninee Rivers.

Whalen, Wyo.—The following are the bids opened on Nov. 1 at the office of the U. S. Reclamation Service, Denver, Colo., for 10,000 bbl. cement (price given per bbl., delivered at Wyncote, Wyo.): Western States Portland Cement Co., Jackson, Mich., \$3; Sunderland Bros., Omaha, Neb., \$3.25, and Wm. Parr & Co., Galveston, Tex., \$3.85. Two informal bids were also received.

Cornwall, Ont.—Citizens of Stormont, Dundas and Glengarry are reported to have petitioned the Ontario Government for financial aid for the River Aux Raisins drainage system, the improvements which will consist of widening and deepening the river; the total cost of the work will be \$97,000. J. J. Leitch, of Cornwall, is reported interested.

PROPOSALS OPEN

For Further see pages 56, 60 and 62.

WATER WORKS.

Bids Clos.	See Eng. Record.
Nov. 14. Pipe laying, Lincoln, Cal.	Nov. 4
Nov. 15. Canals, etc., Buford, N. D.	Sep. 30
Nov. 15. Filter plant, Independence, Kan.	Oct. 21
Nov. 15. Water wks. and filtration plant, Milledgeville, Ga.	Oct. 28
Nov. 15. Well, Perth Amboy, N. J.	Nov. 11

Nov. 15. Boiler, Perth Amboy, N. J.	Nov. 11
Nov. 16. Reservoir, etc., Lebanon, Pa.	Oct. 28
Nov. 15. C. I. pipe, etc., Downers Grove, Ill.	Nov. 11
Nov. 16. Pipe, Providence, R. I.	Nov. 11
Nov. 20. Meters, Chicago, Ill.	Nov. 11
Nov. 21. Tank, Woodland, Cal.	Nov. 11
Nov. 22. Ext'n. of system, Vancouver Barracks, Wash.	Nov. 4
Nov. 22. Fire mains, New York, N. Y.	Nov. 4
Nov. 22. Boilers, etc., Phoenix, Ariz.	Nov. 4
Nov. 25. Reservoir, Ft. Miley, Cal.	Nov. 4
Nov. 27. Boiler, etc., Ft. Screven, Ga.	Nov. 4
Nov. 27. Adv. Nov. 4 to 11.	Nov. 4
Nov. 29. Water works, Davis, Ind. Ter.	Nov. 11
Dec. 1. Water works, Burlington, Wash.	Oct. 14
Dec. 1. Meters, Chicago, Ill.	Oct. 21
Dec. 1. Water wks., Ballinger, Tex.	Oct. 28
Dec. 5. Dam, Glendive, Mont.	Sep. 10
Dec. 6. System, Hammond, La.	Nov. 11
Dec. 15. Canal work, Billings, Mont.	Oct. 21
Dec. 29. Canal, etc., Klamath Falls, Ore.	Nov. 4
Jan. 1. Irrig. work, El Campo, Tex.	Oct. 7
Jan. 2. Water wks., Manila, P. I.	Sep. 30
Tunnel, c. i. pipe, etc., Harrisburg, Pa.	Oct. 7
Adv. Oct. 7.	Nov. 11
Franchise, Chattanooga, Tenn.	Nov. 11
Adv. Nov. 11.	Nov. 11

SEWERAGE AND SEWAGE DISPOSAL.

Nov. 13. Plans, Norwalk, O.	Nov. 11
Nov. 15. Brooklyn, N. Y.	Nov. 4
Nov. 15. Kansas City, Mo.	Nov. 11
Nov. 15. Indianapolis, Ind.	Nov. 11
Nov. 15. Downers Grove, Ill.	Nov. 11
Nov. 16. Des Moines, Ia.	Nov. 11
Nov. 20. Webb City, Mo.	Oct. 28
Nov. 22. Adv. Oct. 28 to Nov. 4.	Nov. 4
Nov. 22. Vancouver Barracks, Wash.	Nov. 4
Nov. 22. Brooklyn, N. Y.	Nov. 11
Nov. 22. Gulfport, Miss.	Nov. 11
Nov. 23. Elyria, O.	Nov. 4
Nov. 23. Chicago, Ill.	Nov. 11
Nov. 24. Shreveport, La.	Nov. 11
Nov. 24. Adv. Nov. 11.	Nov. 11
Nov. 24. Philadelphia, Pa.	Nov. 11
Nov. 30. Baton Rouge, La.	Oct. 28
Nov. 30. Adv. Oct. 28 to Nov. 11.	Nov. 11
Nov. —. Rockport, Ind.	Oct. 7
Dec. 11. Sheldon, Ia.	Oct. 14
Dec. —. Rockport, Ind.	Nov. 11
Jan. 12. Manila, P. I.	Sep. 30
Feb. 1. Woodlawn, Ala.	Oct. 28

BRIDGES.

Nov. 15. Urbana, Ill.	Nov. 11
Nov. 15. Reading, Pa.	Nov. 11
Nov. 15. Springfield, Mass.	Nov. 11
Nov. 17. Garden City, Minn.	Nov. 11
Nov. 20. Memphis, Tenn.	Oct. 28
Nov. 20. Adv. Oct. 14 to Nov. 11.	Nov. 11
Nov. 20. Doylestown, Pa.	Oct. 28
Nov. 21. St. Charles, Mo.	Nov. 11
Nov. 24. Tacoma, Wash.	Nov. 11
Nov. 24. Minneapolis, Minn.	Nov. 11
Jan. 1. Pensacola, Fla.	Sep. 30

PAVING AND ROADMAKING.

Nov. 13. Atlantic City, N. J.	Nov. 4
Nov. 13. Adv. Nov. 4.	Nov. 11
Nov. 13. Jersey City, N. J.	Nov. 11
Nov. 14. Shreveport, La.	Nov. 4
Nov. 15. Brooklyn, N. Y.	Nov. 4
Nov. 15. East St. Louis, Ill.	Nov. 11
Nov. 16. Des Moines, Ia.	Nov. 4
Nov. 20. Webb City, Mo.	Oct. 28
Nov. 20. Adv. Oct. 28 to Nov. 4.	Nov. 11
Nov. 20. Montgomery, Ala.	Nov. 11
Nov. 21. Bayonne, N. J., Adv. Nov. 11.	Nov. 11
Nov. 23. Cincinnati, O.	Nov. 4
Nov. 24. Cincinnati, O.	Nov. 4
Nov. 25. New Orleans, La.	Oct. 21
Nov. 30. Baton Rouge, La.	Oct. 28
Nov. 30. Adv. Oct. 28 to Nov. 11.	Nov. 11
Nov. —. Harrison, N. J.	Oct. 21
Dec. 1. Mattoon, Ill.	Oct. 21
Dec. 1. Cincinnati, O.	Nov. 11
Dec. 8. Cincinnati, O.	Nov. 11

POWER, GAS AND ELECTRICITY.

Nov. 13. New York, N. Y.	Nov. 4
Nov. 14. Jacksonville, Fla.	Nov. 4
Nov. 14. Shenandoah, Va.	Nov. 4
Nov. 14. Washington, D. C.	Nov. 4
Nov. 16. Castleton, S. I., N. Y.	Oct. 28
Nov. 16. Buffalo, N. Y.	Nov. 11
Nov. 16. Washington, D. C.	Nov. 11
Nov. 16. Ft. Hunt, Va.	Nov. 11
Nov. 16. Chicago, Ill.	Nov. 11
Nov. 18. Tacoma, Wash.	Sep. 30
Nov. 18. Philadelphia, Pa.	Nov. 4
Nov. 18. Freeport, Ill.	Nov. 4
Nov. 20. New York, N. Y.	Nov. 11
Nov. 21. Washington, D. C.	Oct. 21
Nov. 21. Pensacola, Fla.	Nov. 4
Nov. 21. Washington, D. C.	Nov. 11
Nov. 22. Baltimore, Md.	Nov. 11
Nov. 23. Newark, N. J.	Nov. 11
Nov. 25. Washington, D. C.	Nov. 11
Nov. 28. Mojave City, Ariz.	Nov. 4
Dec. 2. San Juan, Porto Rico.	Aug. 10
Dec. 2. Ft. D. A. Russell, Wyo.	Nov. 4
Dec. 27. Adv. Nov. 4 to 11.	Nov. 4
Dec. 27. Lockport, Ill.	Nov. 4
Dec. 27. Franchise, Chattanooga, Tenn.	Nov. 11
Dec. 27. Adv. Nov. 11.	Nov. 11

BUILDINGS.

Nov. 13. Htg. etc., Reformatory, Elmira, N. Y.	Nov. 4
Nov. 13. Adv. Nov. 4 to 11.	Nov. 4
Nov. 13. School, Port Richmond, S. I., N. Y.	Nov. 4
Nov. 14. P. O. bldg., Colorado Spgs., Colo.	Sep. 23
Nov. 14. Adv. Sep. 23 to Sep. 30.	Oct. 21
Nov. 14. Drill hall, Ft. Des Moines, Ia.	Oct. 21
Nov. 14. Adv. Oct. 21 to Nov. 11.	Nov. 4
Nov. 14. Boilers in Hsp., Brooklyn, N. Y.	Nov. 4
Nov. 14. School, Webster Grove, Mo.	Nov. 4
Nov. 15. School, Cleveland, O.	Sep. 10
Nov. 15. Plumb. P. O., Burlington, Ia.	Oct. 21
Nov. 15. Jail, Lumpkin, Ga.	Oct. 28
Nov. 15. Bus. bldgs., Florida, Ala.	Oct. 28
Nov. 15. Pub. bldgs., Tompkinsville, S. I., N. Y.	Oct. 28
Nov. 15. Jail, Homer, Ga.	Nov. 4
Nov. 15. School, Purvis, Miss.	Nov. 4
Nov. 15. Almshouse, Palmer, Mass.	Nov. 11
Nov. 15. Improv. pub. bldg., Reading, O.	Nov. 11
Nov. 15. College, Jacksonville, Tex.	Nov. 11
Nov. 17. Pub. bldg., New York, N. Y.	Nov. 4
Nov. 18. Htg., Pub. Bldg., Phila., Pa.	Oct. 28
Nov. 20. School, Danbury, Ia.	Oct. 28
Nov. 20. Park casino, Detroit, Mich.	Nov. 4
Nov. 20. School, Columbus, O.	Nov. 4
Nov. 20. Improv. P. O., Ft. Robinson, Neb.	Nov. 11
Nov. 20. Improv. pub. bldg., New York, N. Y.	Nov. 11
Nov. 20. Hotel Opelousas, La.	Nov. 11
Nov. 20. Alterat. to School, Providence, R. I.	Nov. 11
Nov. 20. School, Kreischerville, S. I., N. Y.	Nov. 11
Nov. 20. Pub. bldg., Providence, R. I.	Nov. 11
Nov. 21. Post bldg., Pipestone, Minn.	Oct. 28
Nov. 21. Jail, Linden, Ala.	Nov. 11
Nov. 21. Almshouse, Jersey City, N. J.	Nov. 11
Nov. 22. Htg., P. O. Bldg., Evanston, Wyo.	Oct. 21
Nov. 22. Adv. Oct. 21 to 28.	Nov. 4
Nov. 22. School, Phoenix, Ariz.	Nov. 4
Nov. 22. Hospital, Gowanda, N. Y.	Nov. 11
Nov. 22. Adv. Nov. 11.	Nov. 11
Nov. 22. School, Ticonderoga, N. Y.	Nov. 11
Nov. 23. Hospital, Ft. Michie, N. Y.	Nov. 4
Nov. 23. Cold storage bldg., Colon, Panama.	Nov. 11
Nov. 27. Improv., Quarantine Sta., Tampa, Fla.	Oct. 28
Nov. 27. Hospital, Pensacola, Fla.	Oct. 28
Nov. 27. School, Brighton, Mich.	Nov. 4
Nov. 27. School, bldg. material, White Earth, Minn.	Nov. 11
Nov. 28. Jail cells, Kansas City, Mo.	Oct. 28
Nov. 28. Pump house, Ft. Du Pont, Del.	Oct. 28
Nov. 28. Adv. Oct. 28 to Nov. 11.	Nov. 4
Nov. 28. Court house, Enid, Okla. Ter.	Nov. 4
Nov. 28. School, Mojave City, Ariz.	Nov. 4
Nov. 29. Post bldg., West Point, N. Y.	Oct. 21
Nov. 29. Adv. Oct. 21 to 28.	Nov. 4
Nov. 29. School, Grand Junction, Colo.	Nov. 4
Dec. 1. Dwelling, Wilmington, N. C.	Sep. 16
Dec. 1. School, Rossmoyne, O.	Nov. 11
Dec. 2. Drill hall, Ft. D. A. Russell, Wyo.	Nov. 4
Dec. 2. Adv. Nov. 4 to 11.	Nov. 4
Dec. 2. Pub. bldg., Philadelphia, Pa.	Nov. 4
Dec. 7. School, Laurel, Miss.	Nov. 11
Dec. 12. Remodel. capitol, Bismarck, N. D.	Sep. 30
Dec. 14. School, Humboldt, Tenn.	Nov. 11
Dec. 1. School, Bloomington, Ind.	Oct. 21
Jan. 1. Hotel, Davenport, Ia.	Sep. 30
Jan. 10. Library plans, Toronto, Ont.	Sep. 23
Jan. —. Hotel annex, Louisville, Ky.	Nov. 4

MISCELLANEOUS.

Nov. 14. Pipe gallery in hsp., Brooklyn, N. Y.	Nov. 4
Nov. 14. Supplies, Washington, D. C.	Nov. 4
Nov. 14. Fence, Ft. Douglas, Utah.	Nov. 4
Nov. 14. Dredging, Nat. Soldiers' Home, Va.	Nov. 4
Nov. 15. Fire alarm tower, Norristown, Pa.	Nov. 4
Nov. 15. Adv. Nov. 4 to 11.	Nov. 4
Nov. 15. Canal Improv., Brooklyn, N. Y.	Nov. 4
Nov. 16. Shovels, etc., Washington, D. C.	Nov. 4
Nov. 16. Remove snow, etc., Brooklyn, N. Y.	Nov. 11
Nov. 16. Levee wrk., Curtis, La.	Nov. 11
Nov. 17. Lead pipe, Chicago, Ill.	Nov. 4
Nov. 18. Cables, Philadelphia, Pa.	Oct. 28
Nov. 20. Concrete wall, Chattanooga, Tenn.	Oct. 14
Nov. 20. Adv. Oct. 14 to Nov. 11.	Nov. 11
Nov. 20. Iron, steel, etc., New York, N. Y.	Nov. 11
Nov. 20. Sand, New York, N. Y.	Nov. 11
Nov. 21. Supplies, Washington, D. C.	Oct. 21
Nov. 21. Supplies, Guantanamo, Cuba.	Oct. 28
Nov. 21. Lumber, Washington, D. C.	Nov. 4
Nov. 21. Supplies, Washington, D. C.	Nov. 11
Nov. 22. Cement, etc., Phoenix, Ariz.	Nov. 4
Nov. 22. Dredging, New York, N. Y.	Nov. 11
Nov. 22. Adv. Nov. 11.	Nov. 11
Nov. 23. Tanks, Ft. Mott, N. J.	Oct. 28
Nov. 23. Adv. Oct. 28 to Nov. 11.	Nov. 11
Nov. 24. Dredging, etc., Philadelphia, Pa.	Nov. 11
Nov. 24. Adv. Nov. 11.	Nov. 11
Nov. 24. Supplies, Panama.	Nov. 11
Nov. 25. Drains, etc., New Orleans, La.	Oct. 21
Nov. 27. Wharf, Pensacola, Fla.	Oct. 28
Nov. 27. Dredging, New Orleans, La.	Nov. 4
Nov. 27. Adv. Nov. 4 to 11.	Nov. 11
Nov. 27. Garb. crematory, Grand Rapids, Mich.	Nov. 11
Nov. 27. Adv. Nov. 11.	Nov. 11
Nov. 27. Dredging, Tarrytown, N. Y.	Nov. 11
Nov. 27. Adv. Nov. 11.	Nov. 11
Nov. 27. Retaining wall, Cincinnati, O.	Nov. 11
Nov. 28. Supplies, Washington, D. C.	Oct. 28
Dec. 2. Quay wall, Key West, Fla.	Oct. 21
Dec. 2. Quay wall, Guantanamo, Cuba.	Oct. 21
Dec. 2. Supplies, Washington, D. C.	Nov. 11
Dec. 7. Wharf, Ft. Moultrie, S. C.	Nov. 11
Dec. 7. Adv. Nov. 11.	Nov. 11
Dec. 9. Electric elevator, Norfolk, Va.	Nov. 11
Dec. 12. Dam, Wheeling, W. Va.	Nov. 11
Dec. 15. Adv. Nov. 11.	Nov. 4
Dec. 15. Telephone system, Billings, Mont.	Nov. 4
Dec. 15. Adv. Nov. 4 to 11.	Nov. 4
Jan. 1. Statue plans, Indianapolis, Ind.	Jul. 22
Jan. 1. R. R. work, Dubuque, Ia.	Nov. 11
Jan. 9. Wharf, etc., Auckland, N. Z.	Oct. 14
Jan. 9. Adv. Nov. 4 to 11.	Nov. 4
Jan. 9. Jetty work, etc., Auckland, N. Z.	Nov. 4
Jan. 9. Adv. Nov. 4 to 11.	Nov. 4
Apr. 2. Harbor Work, Valparaiso, Chili, Apr. 29.	Apr. 29
Apr. 2. Adv. Apr. 29 to Sep. 9.	Oct. 28
Apr. 2. Ditch work, Pomona, Ill.	Oct. 28
Apr. 2. Adv. Oct. 28 to Nov. 11.	Nov. 11

*Items marked thus give the names of parties awarded contracts.